The Electrical World.

VOL. XXVI. NEW YORK, NOVEMBER 9, 1895. No. 19.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. *Cable Address: "Electrical," New York*

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXVI. NEW YORK, NOVEMBER 9, 1895. No. 19.

CONTENTS.

Editorial 509
Electrical Developments at Niagara 511
Magnetic Units 511
Gravity Hook Telephone Patent 512
The Original Berliner Model 512
Electrical Equipment of Public Docks 513
Losses in the Operation of Electric Railways, by Hermann S. Hering .. 516
Water Rheostats, by Geo. T. Hanchett 518
The Rating of Fuse Wires 519
The Invention of the Electromagnetic Telegraph—VII., by Stephen Vail 520
Digest of Current Technical Electrical Literature, compiled by Carl Hering 524
New Book 528
Storage Batteries for Railways, by Maurice Barnett 528
Ornamental Design for Arc Lamps, by Herbert P. Kelly 529
An Improved Fuse Box for Electric Cars 530
The Bacon Air-Lift Pump 530
Earthenware Accumulator Plates 531
A New Friction Clutch Coupling 531
DEPARTMENTS:
Financial Intelligence 532
Special Correspondence 532
General News of the Week 533
Trade and Industrial Notes 535
Business Notice 535
Illustrated Record of Electrical Patents 535

A EUROPEAN ELECTRIC POWER PLANT.

In another column we give an illustrated description of an electric generating plant now in operation at Copenhagen, Denmark, for supplying light and power to one of the largest public dock establishments on the Continent, and which is of particular interest from the evident care with which all of the details have been designed. It is rare that any continuous-current generating plant of any size is installed by a German firm without a storage battery auxiliary, and the present one forms no exception. Here the battery is used as a reserve for lighting, but more particularly to enable generators to be connected singly on three-wire circuits. This method was, we believe, suggested some years ago by Mr. H. Ward Leonard, and has the advantage of largely increasing the flexibility of a system such as the one in question. At first sight it appears rather singular that 110-volt motors are used, particularly as the motors in use require several times more power than the incandescent lights which necessitated this disposition. As, however, the design was probably only adopted after the exhaustive study which Germans usually bestow upon all of the factors entering into any plan they have under consideration, there are doubtless local reasons why 500-volt motors on circuits separate from the incandescent lighting circuits were not installed.

ELECTRICAL DEVELOPMENTS AT NIAGARA.

As will be seen from the account in another column, electrical power at Niagara is proving a powerful incentive to the establishment there of enterprises using electricity in their processes. Among those already established on a large scale, or for which arrangements have been made, are plants for making aluminum, carborundum, carbide of calcium and chlorate of potash, and it is rumored that the self-styled "storage-battery trust" will build a large factory at the Falls. The announcement of the intention of the Carborundum Company to establish, in connection with its reducing plant, works for the manufacture of the raw material produced is significant, as it gives support to the confident claims made that Niagara is likely to become one of the large industrial centres of the country. Still more significant are the statements, that the Niagara company has been so busy considering applications for power from those who want to locate on its lands that the matter of transmitting power to Buffalo has "developed into practically a side issue," and that at present it has hardly enough developed power not contracted for to warrant it to agree to transmit any great amount to Buffalo or to any other place. As the situation appears at present, we fear that the professional electrical public will have to look elsewhere for the practical solution of the problems connected with long-distance electrical transmission of power, which desirable result it was formerly thought would follow the completion of the Niagara project.

FUSE WIRES.

The abstract which we print elsewhere of the Institute paper of Prof. Stine and Messrs. Gaytes and Freeman, on "The Rating and Behavior of Fuse Wires," will be found of much value by the many interested in this subject, for it brings out forcibly several points which, though previously dwelt upon by other writers, have not yet been given the attention in practice that their importance warrants and which it is high time they should receive. This is particularly true in regard to the matter of rating fuse wires in terms of their lengths, and of using, wherever possible, long fuses

For example, it was found that while 15 amperes fused a certain wire eight inches long, 35 amperes were necessary for that purpose with a length of one-half inch of the same wire. The matter of the length of fuse wires, and of their rating according to lengths, should receive the attention of the Underwriters' National Electric Association, for only in this manner can the desired end be fully achieved, and it is not probable that any rules on the subject it may formulate will adversely affect electric lighting interests, provided their application is not made *ex post facto*. The paper again demonstrates the fact that as the diameter of round fuse wire increases it becomes more and more unreliable, and the recommendation to use either ribbon or multiple fuses for currents above 30 amperes should be heeded, as it is one whose desirability is now thoroughly established. The favor with which copper fuses are viewed will scarcely meet with general approval. While on electric railway circuits the conditions are such that their use introduces no element of danger, the reverse is true in most other cases. This is due to the fact that not only do alloy fuses blow at a very much lower temperature than copper fuses, but the disruptive manner in which they give way causes the material to be subdivided in such small particles as to reduce to a minimum danger in their use. The suggestion to use small copper fuses in fibre tubes on lighting circuits would, however, obviate the objection which otherwise can justifiably be urged against this material as a fuse metal for general use. As alloys, owing to the valuable property above referred to, will probably remain the standard fuse material, it would be well if future investigations should also take into account their composition. While manufacturers of fuse wires have probably experimented largely with respect to this point, but little, if any, information on the subject has appeared in print. A series of experiments to show the cause of the wide variations in the capacity of fuse wires made from alloys of presumably the same composition would be of particular value. Such experiments might be made to show the effect of different proportions of the constituent metals and the influence of temperature, both in melting and in drawing and squirting; these factors having probably an important bearing, owing to differences in volatility of the materials entering and different densities of the product.

ECONOMY IN ELECTRIC RAILWAY OPERATION.

In another column we print an article by Prof. Hermann S. Hering, of Johns Hopkins University, giving the practical results of an exhaustive series of tests made on electric railways with a view to determining the numerical value of the various factors affecting economy in operation, and which forms perhaps the most important contribution yet made to the subject. The several factors may be classed into three categories, referring, respectively, to the roadbed and cars, to the motorman and to the running schedule. The influence of roadbed construction, with respect particularly to curves and grades, is illustrated in dollars and cents, and the recommendation to employ efficient civil engineers to lay out a road instead of imposing this duty on the electrical engineer is well sustained. In time electric railway engineers will probably have that part of civil engineering which relates to roadbeds included in their professional instruction, but until then it will in most cases be economy to commit this part of the work to a specialist. In connection with the subject of grades, as well as that of stoppages, comes the question of restoring to the line the energy which is now dissipated at the brakes. In writing of electric traction before it had come to be adopted much stress was always laid upon its advantage in enabling the energy thus lost with other systems to be saved. As remarked by Prof. Hering, there is no system at present in commercial operation which permits this to be done, though, he adds, there doubtless will be when the serious attention is given to the subject which it demands. At the present time the most promising factor from which to expect notable increase in economy of operation is the motorman. It is shown that at least 10 per cent. of energy may be saved by properly instructing the average motorman, which, on the usual city road, will amount to more than $70 per car per year. A road running as small a number as 30 cars would therefore find it economical to keep a skilled man always in its employ to instruct the motormen and see that instructions are obeyed. The economy noted is not the maximum which could be made, and does not include saving in wear and tear, nor consider the greater efficiency in service to the public which would result. The subject of skilled motormen is now, fortunately, given more attention than in the past, as shown by the programmes of recent street railway conventions and the offers of prizes by the management of electric railway companies. The general adoption of the air-brake on street railways, by necessitating a somewhat higher grade of intelligence than at present, would, for this reason alone, be most desirable, and, in view of the figures given by Prof. Hering, in most cases should result in a saving in excess of the higher wages paid. The question of stops is brought out by Prof. Hering in a manner that will attract the attention which its importance merits. It is shown that on a road with thirty cars the cost of a stop at a single place on every trip is no less than $270 per year, not including cost of brake shoes, wear and tear and other factors. Where the practice of stopping at other than street corners is still in vogue, the figures given should lead to its immediate abandonment, and in residence and suburban districts it would be well to take under consideration the advisability of locating definite stopping-places at reasonable distances apart instead of stopping wherever and as often as the car is hailed. In Europe the plan of only stopping at definite points and often at considerable intervals, works well and, as concerns the public, has the advantage of greater speed and less annoyance to those riding. A number of other points of interest are brought out in the article, which as an example of how the result of scientific investigation may be expressed in commercial terms of direct application, will well repay reading by others than those directly interested in the subjects treated.

A Plea for Electric Railways.

An English contemporary, commenting upon what it terms a remarkable article with the above title in an American journal, says that the author sets himself the task of proving the national necessity for electric railways. He finds a resting-place for the vertex of his inverted pyramid in the opening assertion that "the desire for a home is implanted almost as strongly in the human breast as the instinct of self-preservation." Then follow two stanzas from "the Poet Laureate" to show that a man who has a home will have to work for it. Next comes the reflection that when a man has a home he will sometimes want to "go home," and "it is here that the street railway, and particularly the electric road, offers a solution." Country cousins who flock to the cities must not merely be housed, but "if America is to shun the examples of Greece and Rome, and escape their fates, they must be *homed*." It was a French discovery originating in the classic experiments of Marcel Duprez" (*sic*) which renders it possible to go home by electricity. Then follow a number of curves to show how many people go home, and how many miles they go, and what they pay. After all this comes another classic allusion, with the terrible reflection that in the present imperfect means of transit is "the handwriting on the wall, behind which, if unheeded, lurks as grim and inexorable a fate as that which stood in the Chaldean banquet hall; for the public, like the mills of the gods, grind fine though slowly." Our contemporary adds that surely no municipality can be found to resist such arguments as these!

The Use of the Searchlight in Strikes.

A novel sort of advertisement is contained in the last number of one of our English contemporaries. It is stated that at a certain factory, where there was a strike, a searchlight has been used to prevent strikers from setting fire to the temporary sheds erected for the protection of the men at present employed. It is now used regularly to aid the police force to search the surrounding country. In conclusion it is stated that Messrs. So-and-So's searchlight is the one which is used.

Electrical Developments at Niagara.

Ground has been broken on the lands of the Niagara Falls Power Company for a factory to manufacture calcium carbide on a large scale. The first building to be erected there will be of brick, "L" shaped, 40 x 89 feet, and will cost $30,000. The contract calls for its completion by Jan. 1. At the start 1,000 hp will be used, but this will be added to in time, as the building will be so constructed as to permit of enlargement and more power is under option.

The Niagara Falls Hydraulic Power & Manufacturing Company is now preparing plans for its power station on the bank below the Falls. It is from this station that the Pittsburg Reduction Company will receive a power service for the new aluminum factory it is to build on the canal basin. Its contract calls for 4,500 hp. The plans for the power station provide for a building about 120 feet wide by 60 feet long, but ultimately the length will be made 180 feet. This contract and service will make necessary the construction of a new flume from the canal basin to the river bank, the water being carried down the bank by penstocks, as in the case of the Cliff Paper Mill. The electrical power to be used by the Reduction Company in this factory will be delivered to it on top of the bank. Besides this, the Reduction Company has secured an additional 2,000 hp from the Niagara Falls Power Company.

Another industry soon to be established is the manufacture of chlorate of potash, the Niagara Falls Power Company having recently leased about 700 hp for this purpose.

The Carborundum Company proposes to construct a factory for making wheels, hones, etc., to be operated in conjunction with its new plant, just started. The construction of this new factory will result in the abandonment of the plant in Monongahela City, Pa. It will also necessitate the erection of an additional large building, to contain two large kilns, each of which will be 16 feet, interior diameter, or six times the capacity of those formerly used by the Carborundum Company in Monongahela City: the product of the Niagara furnaces will be 2,000 pounds a day, while that of the Pennsylvania furnaces was only 300 pounds every 24 hours.

Public discussion of the great desire of Buffalo to enjoy the benefits of Niagara power has ceased for a time, owing to the fact that further consideration of the matter has been postponed until after the election. It will be recalled that Buffalo thought she had offered a franchise which the power company would be pleased to accept, but in a communication Secretary Rankine informed it that his company could not agree to pay 5 per cent. tax. Buffalo then became indignant, and newspapers, which before had been friendly to the Niagara company, acted as though this was the straw that broke their allegiance, and accused Mr. Rankine of neglect in not mentioning this fact earlier. There has been so much delay in considering the matter that now the power company claims it has hardly enough developed power that is not contracted for use at Niagara to warrant it in agreeing to transmit any great amount to Buffalo or any other place. The fact seems to be that the Niagara company has been so busy considering applications from those who want to locate on its lands that the Buffalo matter has developed into what is practically a side issue.

Nothing has been heard of late relative to the New York Central's intention to equip its Buffalo-Falls branch with electricity, but there is reason to believe that the "Great Four Track" people are keeping well posted on the success met with in building electric locomotives, with a view of using them on this and other branches of their road where it might be found desirable. This road is one of the most progressive in the country, and there are those who expect it to announce its intention at any time to adopt electricity on more than one of its branches—for instance, the Buffalo, Falls, Lewiston and Lockport branches, all of which are short lines. During the construction of what is known as the "Ely" trolley line between Niagara City and Buffalo, the New York Central was so accommodating in every way that some people look to see that company turn up as the owner of the electric road before long. The same may be said of the "Gorge Road," it being generally thought at Niagara that the New York Central will have to control this road to properly protect its interests in travel.

Loss of Heat from Unlagged Piping.

An English engineer states that from each square foot of bare metal surface of pipe or flange under steam there is dissipated heat at a rate equivalent to the consumption of half a ton of coal per annum.

Magnetic Units.

To those who are still interested in the magnetic unit question, we commend for perusal the remarks made thereon by our American contemporary, *The Electrical World*. Whether or no these criticisms represent the deliberate opinion of scientific men and dynamo-designers across the ocean, we cannot say; at any rate, they strike us as exceedingly just, not to say exceedingly obvious. "Ill blows the wind that profits nobody," and amidst the confusion which seems likely to arise from the conflict between the English and American proposals, the peaceful Briton may console himself that at any rate a few more years will roll by before he is called upon by the unanimous voice of the leaders of electrical science all over the world to adopt a system of units and names for which he has never expressed any decided desire.

The whole of this magnetic unit controversy is an amusing instance of the way in which mere vociferousness carries the day, even in the calm circles of science. The practical man, taking his cue, as he should do, of course, from his scientific superiors, submissively and gratefully adopted the pure C. G. S. system of magnetic units for his designing work as soon as magnetism became an article of commerce; the only emendation made by him being the adoption of the "ampere-turn." Under the circumstances, therefore, one would have thought he might well have been let alone. There seems, however, every likelihood that he will be ultimately forced *nolens volens* to use names and units he has never clamored for and would rather be without. Such is the irony of fate! Of course, had the practical system sanctioned by usage been a mere mass of irrationality, scientific men would have had the weight of argument to oppose to the dead-weight of custom. But in this case the system sought to be overthrown is one of science's own devising, and one which "practicians" have for once in a way found tolerably suitable for every-day use.

We are told by our New York contemporary that the ELECTRICIAN which has always expressed itself in opposition to specific names for magnetic units, in summing up a recent and extensive correspondence on the subject in its columns frankly admitted *a strong drift of opinion* favoring such names." The italics are ours. What we *did* say was as follows: "The correspondence in our columns is a proof that, while there exists a strong feeling against tampering with old units or coining needless new ones, there apparently is some need for names to fit those actually in use. . . . While objecting to the wholesale creation of fantastic names, and units of more than doubtful utility, we are ready to admit that something like a case has been established for recognizing by a definite name the unit of magnetic flux.—*London Electrician.*

[We regret having inferred from the remarks of our contemporary an opinion which, we now learn, is not held by it to the extent implied by us. In writing the sentence referred to we associated—unjustifiably, it seems—with the remarks above quoted the opening paragraph of the same editorial, which reads as follows:

"In summing up the correspondence which for some weeks has been actively pursued in our columns, we are impressed by the sense that these letters—many of them from men the best qualified to judge (at least so far as Great Britain is concerned) as to the practical value of a system of magnetic units—have done much to clear the air of cobwebs. Whatever, therefore, the British Association, or its Committee on Electrical Standards, may decide to adopt or to leave aside, they cannot be ignorant of the strong drift of opinion which has made itself known in these letters."—ED.]

Small Lighting Accumulators.

In an abstract of a recent article by Mr. Loewenthal, in our Digest of Oct. 19, attention was called to an apparent discrepancy in the figures given. The author has sent us an explanation, which is to the effect that the weights given are those of the complete battery, including the casings. The carriage battery is placed in a heavy box containing a large amount of acid; the weight of all these accessories is 7 pounds, leaving 7 pounds for the plates. The bicycle battery, on the other hand, is in a small light rubber cell containing very little acid; the weight of the plates is 2 pounds. This makes the ratio of the weight of the plates as 1 to 3½, and not as 1 to 5, which is the ratio of their weights complete. Furthermore, the bicycle cell plates are specially designed for their purpose and are made in a different way from those of the large cells.

Gravity Hook Telephone Patent.

There has been a rumor in telephone circles that the patent on the gravity telephone hook expires on Nov. 5, with the Watson patent, No. 209,592, dated Nov. 5, 1878, which patent claims: "A telephone holder consisting of the combination of a yoke on the end of a lever of the first order, made to tilt by the removal of the telephone, with two stationary points, one making circuit connection through the signaling or call instrument, the other through the telephone, substantially as herein shown and set forth."

From this claim it will be seen, however, that the patent merely applies to details, and in other respects is subordinate to the Roosevelt patent, No. 215,837, of May 27, 1879. In fact, it contains a disclaimer to this effect, as follows:

"Having thus described my invention, I would observe I do not claim to be the first and original inventor of the automatic changer operated by the weight of the telephone. In this I believe to have been anticipated by H. L. Roosevelt."

The Watson combination above referred to is shown in Fig. 1, and Fig. 2 shows the Roosevelt device of patent No. 215,837. The first claim of the Roosevelt patent is as follows:

"The combination, with a telephone, of a circuit closing or changing portion and screws or points, the circuit closing portion being arranged to be placed in contact with one screw-point through the influence of the telephone, when not being used, and to be placed in contact with the other screw or point when the spring is freed from the influence of the telephone, substantially as described." The second claim reads: "The combination of a spring-switch, connecting wire connected therewith, and a transmitting instrument suspended thereto, substantially in the manner described, whereby the raising of the transmitting instrument causes the spring-switch to make or break or alter the electric circuit."

These appear to be the two broad claims. The Watson application was filed Sept. 17, 1877, while the Roosevelt application was not

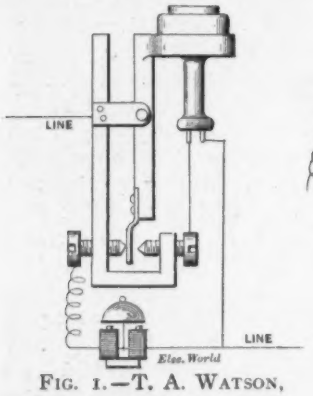


Fig. 1.—T. A. Watson, No. 209,592, Nov. 5, 1878.

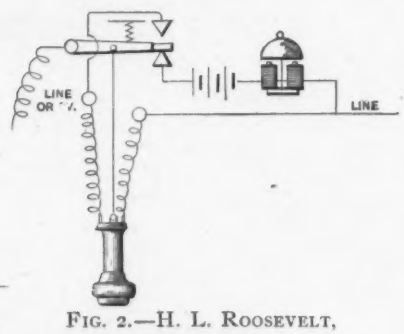


Fig. 2.—H. L. Roosevelt, No. 218,837, May 27, 1879.

filed until Oct. 3 of the same year. It appears, however, that Watson and Roosevelt went into interference on the invention, either within or without the office, and that the fundamental patent was issued finally to Roosevelt. No foreign patents were taken out on either of these inventions as far as known. It would thus appear that the gravity telephone-hook does not expire until May 27, 1896, although of course the question of extent of invention in the Roosevelt patent is an open one.

The Watson patent, No. 270,522, Jan. 9, 1883, is claimed to be the fundamental telephone-hook patent for a combination of the induction coil with the telephone circuit. As has previously been stated in our columns, Watson in this patent simply claimed any form of a switch which would automatically perform or establish a certain set of electrical connections. Thus, the first claim reads:

"In combination with suitable contact-points and springs electrically connected with the call circuit and the primary and secondary circuits of a transmitter, the latter circuit including the hand telephone, a lever electrically connected with the main line in a telephone circuit, substantially as described, to bring in the hand telephone and transmitter and break the call circuit, or to cut out the hand telephone and transmitter and establish the call circuit, according as the lever is moved in one direction or the other." This latter Watson patent is also uninfluenced by any foreign patents as far as known.

Other methods of accomplishing the desired results by means of a different set of electrical connections have been invented and patented by Warner, No. 284,102, Aug. 28, 1883, by Scribner, and by Carty in his party line patent, previously referred to in our columns. It is claimed that other methods of establishing suitable circuit connections are possible, and the Clamond Telephone Company, of Philadelphia, is at present using one such method, which is claimed to be entirely distinct and different from the circuit connections of Watson, Warner, Scribner and Carty.

The Original Berliner Model.

In a printed brief, dated June 14, 1894, of the American Bell Telephone Company, which was used in presenting its defense in the Berliner case before Judge Carpenter, a section under the head of "Tests of Berliner Transmitters" refers to several experiments made to demonstrate that the original Berliner apparatus was operative. A letter written by

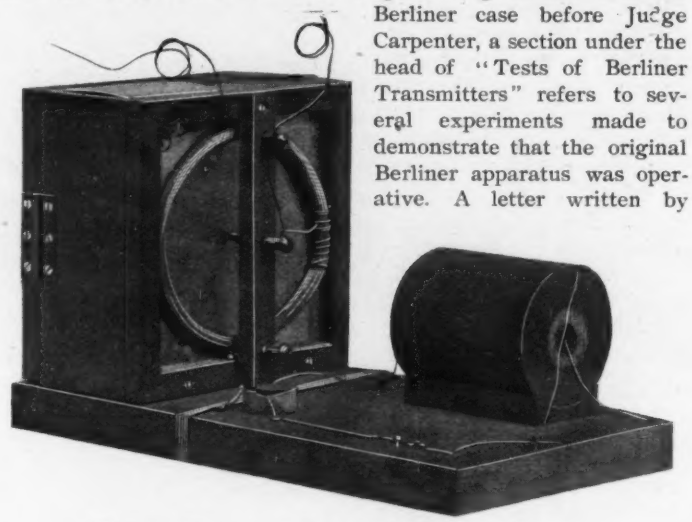


Fig. 1.—Certified Copy of Berliner Model.

Prof. Cross, dated March 6, 1880, and addressed to Mr. J. J. Storrow, which is offered in evidence, reads as follows:

"We tried Mr. Berliner's transmitters this afternoon, using both forms, the plate and knob described in his caveat, and the plate and point described in the application. The adjustment was quite delicate, but after this was arranged, using a Bell receiver, we were able to converse with both forms of instrument. This settles the first of the questions."

The brief then proceeds to say that Mr. Storrow had the above experiments repeated in his presence on Feb. 24, 1881, and adds: "At the latter, and probably at the former, there was used *a fac-simile of Berliner's filed model, which fac-simile was made by the Patent Office*, and certified by it under date of Dec. 10, 1879. It is an exhibit in this case." (The italics are as in the original.)

The duplicate above referred to we illustrate in Fig. 1, which is a reproduction of an engraving appearing in the brief quoted. A paragraph relating to the engraving is accompanied by a foot note which reads as follows: "The complainant appears to have lost the original Berliner model. The copy of Dec. 10, 1879, is therefore very precious, and to avoid accidents of use we have of late more often used a fac-simile of it."

In Fig. 2 we illustrate the original Berliner model, which is now at Chicago in possession of Mr. Henry C. Strong, the early telephone inventor. While in the Patent office in 1885 Mr. Strong accidentally discovered that the Berliner patent model of June 4, 1877,

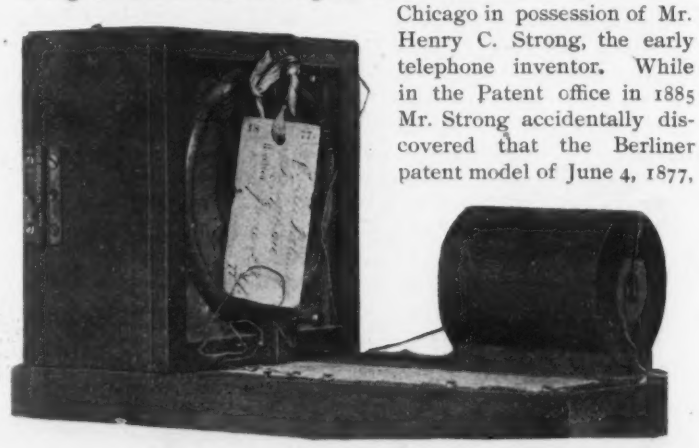


Fig. 2.—Original Berliner Model.

was abandoned, and he immediately applied for its purchase, under the order of Commissioner Benton J. Hall, the terms of which directed that all abandoned models be sold.

Electrical Equipment of Public Docks.

THE Public Docks Stock Company, of Copenhagen, were recently confronted with the interesting and up-to-date problem of installing an electric light and power plant on their projected docks, especially adapted to supply power for the loading and unloading of vessels and eliminating all other forms of power for this purpose, such as steam, gas, hydraulic and compressed air.

It was proposed to make the application of the power developed in a central station so general that longshoremen would be dispensed with and the employees would be only those necessary to tend machines, manipulate controllers and watch automatic apparatus. From the beginning it was conceded that only electricity could solve the problem, as the application of the power was to be in all directions and cover a considerable area. The development and execution of this primary idea was left entirely in the hands of Allegemeine Elektricitats Gesellschaft, of Berlin, and as the problem was in an entirely new field their mode of treating it will, therefore, be of interest, particularly as the docks have been open since the end of November, 1894, and consequently the installation has been under a thorough working test.

The public docks district comprises about 153 acres in the northern portion of Copenhagen—91 acres of land and the remaining 62 acres of land-locked water. As almost all the moles and docks were reclaimed land and built of material dredged from the harbor bottom, the conduit distributing system proved a difficult undertaking. The four basins constituting the public docks are the East, West and Middle basins and the North harbor, the latter two being used for ships whose cargoes, like coal or wood, do not need shed protection, while the two former are intended for handling perishable cargoes and are provided with warehouses and sheds. All basins are bounded on three sides by a sea wall, the total length of which aggregates 2.36 miles. The depth of water is from 24 to 30 feet at the innermost sea walls. The entrance to the harbor is protected by a breakwater. A plan of the district is given in Fig. 2.

The East and West basins are divided by the middle mole, 1,030 feet long and 184 feet wide, on which stands a nine-story grain elevator and a large iron pier shed. On the western, the basin side, of the East mole, there is a four-story masonry warehouse, No. 1, and a two-story masonry dock building, between which lies the central heating plant. Along the eastern side of this 3000-foot East mole, there is an 820-foot two-story shed, with a promenade, the "Lange Linie," on the roof.

The electric power-station is located at the head of the West basin in proximity to the customs house, general offices, police house, railway sheds, and and also a building where ship's stores are sold. Other projected buildings, particularly on the West Quai, are in course of construction and will be completed as necessity demands.

The central station, shown in Figs. 1 and 3, is designed for a normal output of 200 kilowatts, but it is capable of delivering 260 kilowatts, not taking into account any energy from the accumulator batteries. The contract called for 170 hp for power, and the remainder for light-

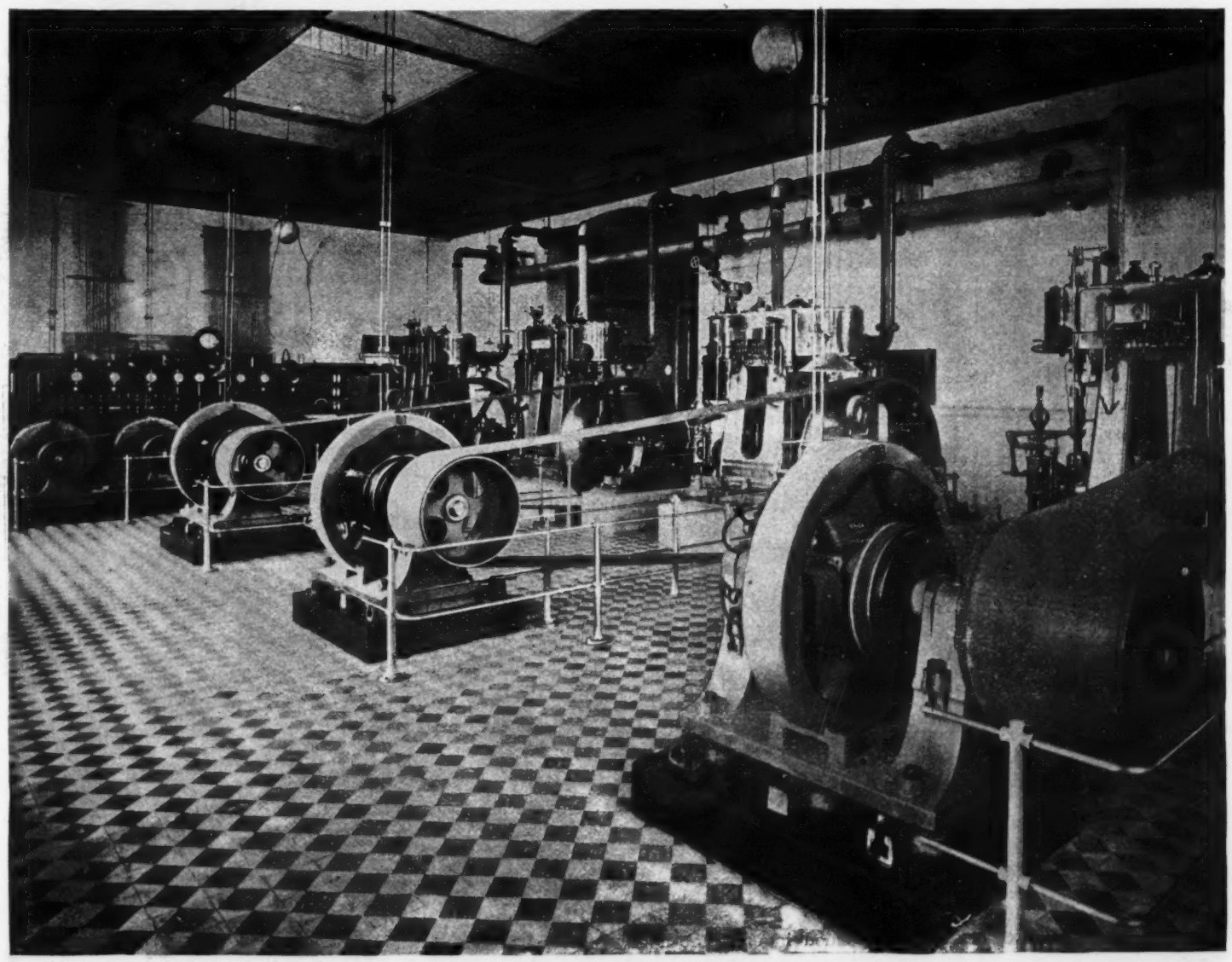


FIG. 1.—ENGINE AND DYNAMO ROOM.

ing purposes. Three water-tube boilers supply steam at 150 pounds above atmosphere with about 1,130 square feet of heating surface per boiler. The grates are for anthracite fuel and the use of automatic conveyors and smoke consumers has not been neglected. The dimensions of chimney are twice as large as necessary, in view of future increase of boiler plant. City water is used, and the engines are condensing with surface condensers, having a purifier for separating oil, etc. The condensers with air and circulation pump are all in duplicate, partially to make them independent of the other machines, and also to be in reserve during long continuous runs of the engines.

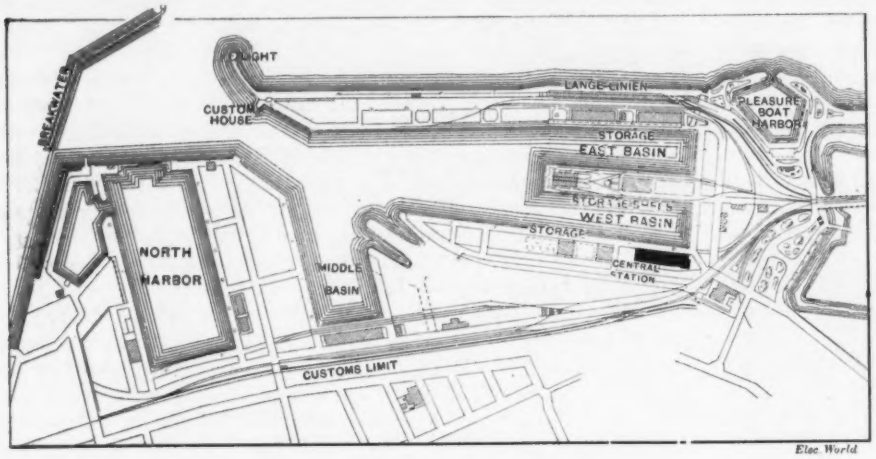


Fig. 2.—Plan of Docks and Warehouses.

Fig. 1 shows the engine room, which contains four vertical compound engines with piston valves and cut-off regulated by pendulum governors ; each has a normal capacity of 100 hp, at 210 revolutions per minute, and all were built by the Allgemeine Elektricitats Gesellschaft.

The engines drive two four-pole dynamos of 240 volts and 135 amperes at 730 revolutions per minute, and three six-pole dynamos of 240 volts and 220 amperes at 490 revolutions per minute. The fields of these dynamos—the cores and frame of which are of steel—are excited from the storage batteries. Their voltage can be increased to 350 for charging the storage battery plant.

The storage battery is of 800 ampere-hours capacity, and consists of two sets of 70 cells each, the charging voltages of which are regulated by automatic switches. A diagrammatic representation of switchboard is given in Fig. 4. A smaller board at right angles to the main one carries all of the voltmeters.

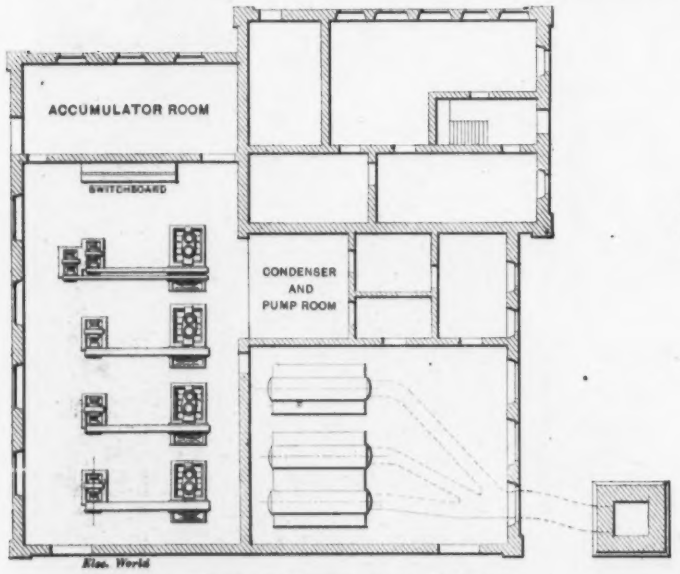


Fig. 3.—Plan of Generating Station.

The electric distribution is accomplished by two distinct three-wire systems, one of 240 volts for power, and another of 110 volts for lighting, though the latter may also be used for small motors having a somewhat constant power consumption.

In planning the plant the economy depended in a measure upon the consideration that only one machine should be brought into reserve use for both power and lighting, which arrangement was carried out by having the storage batteries as reserve for lighting, and, further by having each generator ready to switch onto the power or lighting systems, or onto the positive or negative branch of the three-wire system. Fig. 5 shows the method of switching a 240-volt machine on the three-wire system of 110 volts.

The lighting distribution is on the same plan as a city system with distributing centres, while current for power is carried in ordinary mains to the motors. Two separate distributing systems are used, as the consumption of power far exceeds that of light, there being 460 hp installed in motors while only 110 hp are used at the same time for lighting. Furthermore there are motors which, running full, require over a third of the capacity of one of the machines, but yet have very variable loads. The end might have been accomplished by a larger storage battery which would, however, have been out of all proportion.

All the mains for power current have been given equal section as a constant load on the two sides of the system could not be relied upon. In the lighting system, on the contrary, the middle wire has only about one half the section of one of the outside wires, which are figured for a 10 per cent. drop in the feeders and 1 per cent. in the distributing lines. The drop in the power lines is less. The aggregate amount of cable and wire for the main lines approximates 22 miles, almost equally used in three different ways, namely: 1. As underground cable. 2. As naked wires in traversable subways. 3. As overhead wiring on poles.

The underground cables are used exclusively south of the docks where the office buildings are located. About the East Basin and West Basin, subways about five feet seven inches high are built in the quai walls to carry the feeders to the warehouses and elevators. A section of the same is shown in Fig. 6, which also shows the wall brackets. The lines running to the North Harbor for power or lighting are carried in the ordinary overhead way. As evil results were feared from the sea water that might percolate into the subway, the copper conductors and brackets are coated with marine shellac; and as part of these ways is below the sea level, the water that does collect in them is led to a collecting well and by means of a centrifugal pump is returned to the sea.

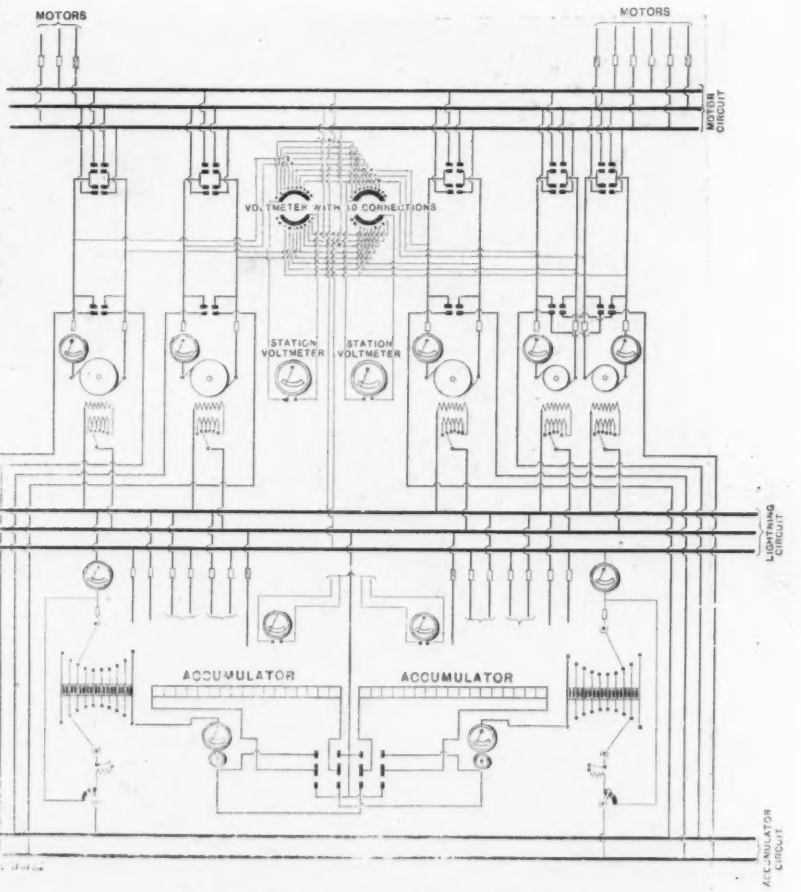


Fig. 4.—Diagram of Station Circuits.

The all-important feature of the installation is, however, the application of the electrical power in the warehouses. In the high grain elevator on the middle mole there are six bucket elevators, each operated by a 15-hp electric motor. For all elevators or cranes the capacity of the motors installed is such that day or night they will be able to do full duty, even under extraordinary conditions, with safety. The grain is carried to the ninth story, falls to the weighing hopper on the eighth, and then is shot into bins on the lower floors. In case sacks have to be handled, there are two hoists on the outside of the building, each run by a 12-hp winch located in vaults, which are equipped with as much care and are as noiseless as the machinery for passenger elevators, having automatic stops, etc. Their maximum service is one ton raised 20 inches per second.

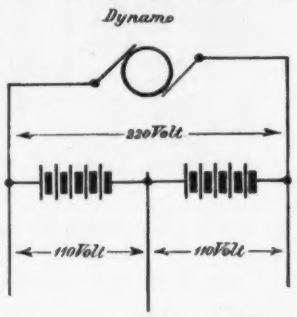


FIG. 5.—CONNECTIONS FROM 2 TO 3-WIRE CIRCUIT.

In the cellar vaults there are two 15-hp motors, each driving six belt conveyors. One of these motors is shown in the initial. Two more electrically driven belt conveyors are in the seventh story. All other machinery for the building is in the top story (see Fig. 7), and this includes six motors for elevators and one for belt conveyors, which latter also runs a blower to clean the grain of chaff and dust as it falls into the weighing hoppers. An 18-hp grain-cleaning machine is located on the second floor. Thus, with the exception of one man to tend the scale, a whole grain cargo is handled entirely by machinery.

On the eastern sea wall of the middle mole two portal cranes, the mountings of which straddle a standard freight car when loading, travel the length of the grain elevator. These are similar in construction to cranes erected by the same company in 1891 on the Patèrsen Quai in Hamburg. The cranes are moved on their tracks by hand-power. For turning the crane on its turret a 4½-hp motor is used, and beside it a 20-hp motor does the lifting, both being covered by a corrugated iron cab on the framework of the crane. Rawhide gears are used to diminish the noise. It had been stipulated that one man should operate each of these cranes, the levers of which are the same as a locomotive valve gear lever and all within easy reach at the same time, and can be handled with very little effort. An electric brake stops the crane if by accident the current is broken. A point of economy is the turning into the line of the current, which is often of considerable quantity, from the motor when transformed into a generator by the descending loads.

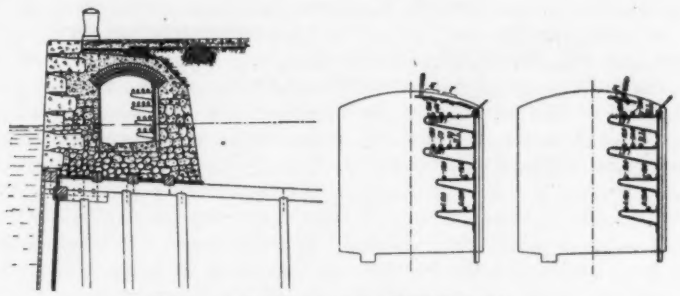


FIG. 6.—SUBWAY FOR CONDUCTORS.

With a load of 3300 pounds these portal cranes have lifted 2 feet and turned 5 feet in one second. The reach from the crane centre to the centre of the pulley wheel is 34 feet. Besides incandescent lights in the cab, the crane carries one arc lamp over the centre and a transportable one which can be hung on either side of the steel framework, as most convenient. The travelers are also supplied with two

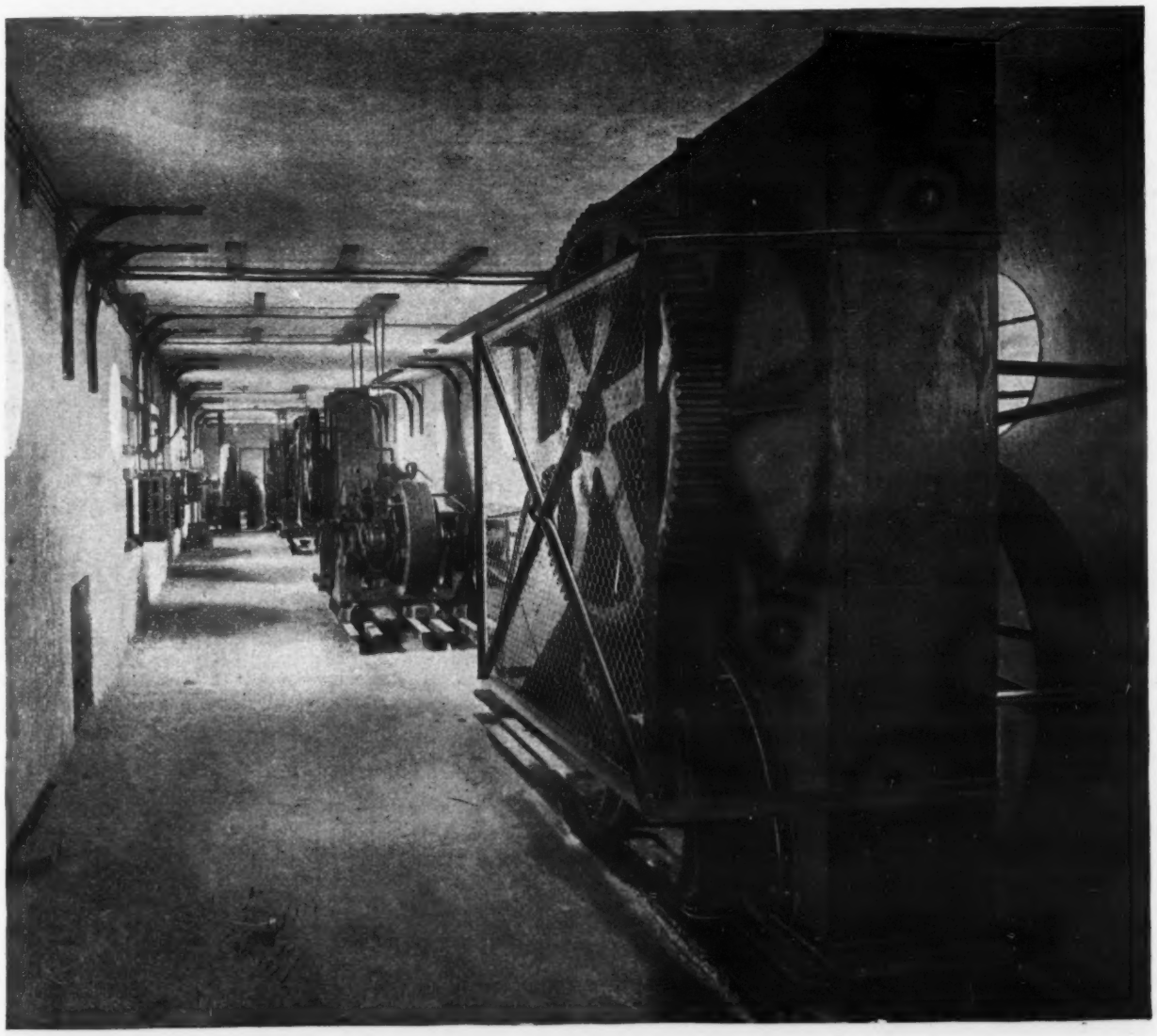


FIG. 7.—ELECTRIC ELEVATORS AND CONVEYORS.

drums carrying cable coils, one for the power and the other for the lighting circuit. When in one position for a day or so the cranes are clamped to the tracks to give them more stability. To limit the rotation of the crane the motor is cut out of the circuit after passing the defined position.

With all the preceding apparatus a cargo of grain of 2800 tons has been discharged, weighed and stored in 31 hours with but 700 kw-hours of electrical energy, while primitive methods would have required 8 to 10 days with great cost for manual labor.

The freight elevators in the warehouses and dockhouses on the basin side of the east mole, are of particular interest. They are installed with the greatest care for the greatest safety, and according to the "Police Regulations for the Installation and Operating of Elevators," of Berlin. They are operated by direct-coupled 12-hp motors and worm gear, and can be controlled from the cage or from any floor outside of the shaft. A load of 3300 pounds can be raised at a speed of 16 inches per second. The automatic controlling of the motor and the automatic stopping of the elevators at any floor is precise and accurate in the extreme. The warehouse has six elevators in pairs (making it possible for one attendant to manage two), for work on the quai side, while six electric hoists to load and unload trucks on the street side. The hoists are connected with the motors by gear wheels, and a mechanical brake permits holding the load in any definite position.

The dock house has two freight elevators on the quai side and one on the street side, all similar to those just described, but of smaller capacity. There are likewise two elevators in the "Lange Linie" shed on the sea side of the east mole, with 6½-hp motors. Five traveling swivel cranes run the full length of the previously mentioned 885-foot platform. Their mounting is in the form of an angle spanning a standard freight car-load, with the vertical leg of the angle reaching to a rail on the sea wall, while the horizontal leg reaches a track under the edge of the second-story platform, and carries the turret with crane, cab, etc. In other respects these angle cranes correspond to the portal cranes on the middle mole. In a warehouse in which space is let for industrial purposes electric motors are used largely for coffee cleaning and sorting machines.

There are now on the lighting circuit 107 arc lamps of 6, 10 and 15 amperes and about 2,000 incandescents of 16 cp; for the harbor illumination there is never more than 650 amperes used.

For greater convenience the docks are furnished with a great many sockets for both incandescent and arc lamp connections, and also cable coils for longer connections, so that lights can be placed at any desirable point, even to hanging in the rigging of the ships at the docks when desired. Furthermore, there are portable arc lamps in large number, which, with a portable cable box, resistance, fuses and switches, can be cut in anywhere and used.

The Standard Telephone Company at St. Louis.

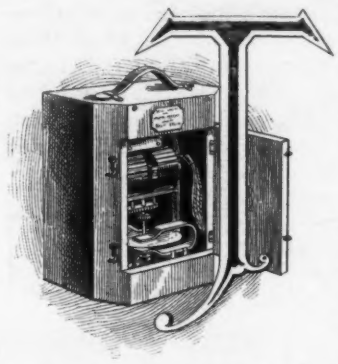
If the reports about the Standard Telephone Company are true, Judge G A. Madill, president of the Union Trust Company; William H. Thompson, president of the Bank of Commerce, and thirteen other prominent financiers and capitalists in St. Louis have been badly victimized by one of the shrewest manipulators in the country.

During the Summer John W. Candler, a Boston banker and railroad president, came to St. Louis, and acting under instructions from Allen W. Nye, of New York, who poses as an inventor and owner of several telephone patents, succeeded, with the assistance of Griffith Colt, in organizing the Central Standard Telephone Co. to control the telephone rights in Missouri, Kansas, Arkansas and Nebraska. The company was capitalized at $5,000,000, with fifteen directors. Each of these directors paid in $1,000 in cold cash and accepted in return $50,000 each in stock, or $750,000 in all. The balance of the $5,000,000 capital stock went to what is known as the parent company in New York.

These fifteen directors are men whose names are calculated to inspire confidence in almost any undertaking, but the Standard Telephone Company is one of the things that did not go, and all they have to show for their $1,000 apiece is worthless paper that is worse than blank. Mr. Candler, who aided in forming the company, is not blamed by anybody among the St. Louis victims, as he seems himself to have been victimized by shrewder men than he, in addition to lending his name to the scheme.—*St. Louis Post-Dispatch.*

Losses in the Operation of Electric Railways.

BY HERMANN S. HERING.



THE loss of a few per cent. upon small expenses or moderate capital may usually be neglected; but when losses occur very frequently or are based upon large sums, they aggregate an amount that should be considered. A few of the losses which are not usually referred to, and still less frequently avoided, have been investigated by the writer in a preliminary way, with a view to determine their magnitude and to examine them more thoroughly if they are of sufficient importance. The losses to be discussed here are those due to defective roadway construction, to the manner of handling the controller, to stopping and starting, and to carrying additional dead weight on the car.

Roadway.—A straight, level, well-laid track embodies the ideal conditions that should be approached as nearly as possible. All curves, grades and irregularities in the track, increase the watt-hours per car-mile, and as this increase on a given track represents a continual consumption of energy, it amounts to a large quantity in the aggregate.

The rails should be of the best kind, heavy, well laid on a firm foundation with perfect alignment. When the alignment is bad the friction is increased and the see-sawing of the cars limits the speed and is apt to make the trolley jump off.

The curves should be compound, and have as large a radius as possible and ample pitch for high speed. The smaller the radius, the larger the amount of energy required to run the car over the curves; if the radius is very small, necessitating a slackening of the car speed on approaching the curves, the number of watt-hours required is still further increased by the loss of the car's kinetic energy which must again be supplied to it in bringing the car up to speed. Double trucks have an advantage over single trucks, in that the friction is but slightly increased on curves, whereas the increase with single trucks is considerable.

The grades should be made uniform, and those of a short, "choppy" kind be avoided, as they introduce irregularities, and the down-grade portions of them are not usually made use of for drifting, being short and possibly steep. The gain in a down-grade is mainly that it enables the car to drift, as otherwise the watt-hours are still further increased by the car using power on the down-grade as well as on the up-grade, or else the brakes are down hard and most of the car's potential energy is lost.

Large vertical curves should be placed between the grades in order to avoid sudden changes in the direction of the car's motion, which also frequently results in a loss of energy.

These requirements for proper roadway construction seem obvious and essential, but as so many of them are disregarded in important roads, even at this late day, it does not seem amiss to mention them again. One instance in mind is the case of a prominent road, which, at the top of an 8 per cent. grade, not only has a vertical curve of ridiculously small radius, but also a sharp reverse curve on this vertical curve. This is a most undesirable condition, and in this instance was totally unnecessary The foot of this grade also has a very small vertical curve, necessitating a slow speed where a high speed would result in a considerable saving. On a portion of this same road, presumably built for high speed, two sharp reverse curves occur for no apparent reason, thus causing not only a considerable decrease in speed, but a loss of energy as well.

Defective switches and special work also result in a continual loss of energy as they require each car to slow up on every trip, which always results in a loss of energy unless the brakes are not used.

The fault lies partly in the fact that the civil engineering work of roadway construction is seldom designed and superintended by competent civil engineers. The managements of the companies, in a mistaken endeavor to economize, either employ inefficient engineers or else require their electricians to add that to their already numerous duties, and very few electrical engineers have sufficient experience to attend to this feature of the work properly. It invariably pays in important work to employ specialists, as there is enough in each branch of engineering to engross individual attention, and an attempt

at a combination invariably results in a sacrifice in one or all. The old adage: "A jack of all trades is a master of none" applies directly to this "multiphased" engineer. During the past few years, however, the roadway construction of electric railways in general has greatly improved, as experience has demonstrated the economy of first-class work.

The advantage resulting from a removal of five turnouts, the alteration of some short grades and the enlargement of some of the curves, was shown in a test made on a well-built, single track road, and repeated on the same road after a portion of it (68 per cent.) had been double-tracked and the alterations made. The road was suburban and the track consisted of 54-pound T rails, laid on oak ties and eight inches of stone ballast. The car was operated by the same motorman in both cases and was run at maximum speed. Owing to there being five turnouts less and to the fact that most of the curves were reconstructed for high speed, the time of the trip was reduced, and consequently the speed increased 12½ per cent., while the average current was decreased 12 per cent. on the up-grade trip, and 7 per cent on the round trip. This difference is due to the roadway alone, as the other conditions were the same in both tests. The fewer number of turnouts, switches and sharp curves permitted more uniform speed. A much greater difference would have resulted had the road been poorly constructed in the first place.

Handling the Controller.—The manner in which the controller and brakes are handled by the motorman has a very important effect upon the consumption of energy by the car. By far the largest part of the electrical energy used by the cars is expended in accelerating and lifting them; the amount required for horizontal propulsion being comparatively small. In the suburbs and sometimes in the city, the grades are the main consideration in the design of the electrical equipment of the roads. In city work where stops are made at all or nearly all street crossings the energy required by the car is mainly for the purpose of starting, as there is but little uniform speed. The energy used in starting and propelling it up-grade is stored in the car as kinetic and potential energy, less the amount lost in the mechanism and in rolling friction, and can largely be made use of in propelling the car after the current is shut off, by allowing the car to "drift." For instance, a car and passengers, weighing 17,200 pounds, or 8.6 tons, and with a traction coefficient of 12 pounds per ton, would require a horizontal draw-bar pull of 103 pounds on the level. At a speed of 10 miles per hour the kinetic energy would be 57,500 foot-pounds, which would enable the car to drift 560 feet, theoretically, and probably about 300 feet actually. The speed decreases nearly in proportion to the distance the car drifts.

In going up a three per cent. grade for 500 feet the potential energy stored in the car would be 258,000 foot-pounds. In going down the same grade, the force exerted on the car, which is the component of the weight along the grade, would be 516 pounds. Subtracting the friction, that is, the draw-bar pull on the level, 103 pounds, leaves 413 pounds not required, which either produces acceleration or is wasted in the brakes. The energy required to propell the car down this grade is the friction, 103 pounds times 500 feet, or 51,500 foot-pounds, which subtracted from 258,000, the potential energy at the top of the grade, leaves 206,500, which is a surplus and is stored as kinetic energy in the car in reaching the foot of the grade, if no brakes are used. The velocity of the car at the foot of the grade would be 27.8 miles per hour, and with a friction of 103 pounds the car would go about 2,000 feet on a level after reaching the bottom of the grade, due to its own momentum, assuming the friction to be constant. Actually, this would be much less, due to the wind resistance and the increased friction at higher speeds, etc., but even at 50 per cent., that is, 1,000 feet, the distance would be three times the length of the up-grade, or 1,500 feet from the top of the grade to the point where the car would stop. This shows the great amount of energy stored in the car in going up-grade, which is mostly wasted by the brakes in slowing up and stopping on down-grades. Although it is impossible in many cases to run under these ideal conditions it is nevertheless important to construct the road with this question in mind, and also to avoid the use of brakes as much as practicable. Motormen frequently use current on a down-grade, where it is totally unnecessary, and then jamb down their brakes when reaching the foot of the grade, which results in a total loss of this energy.

The energy stored in starting a car, and not used for propulsion, is absorbed when the car is brought to rest or its speed slackened by means of the brakes and is dissipated in the form of heat. By far the largest amount of the energy used in running a car, especially in city work, is used in accelerating and lifting it. For instance, the energy used per car-mile in a city road is about 1,300 watt-hours, which is the equivalent of 3,450,000 foot-pounds. The effective energy at the car axle, averaging about 60 per cent. would be 2,070,000 foot-pounds. The horizontal traction per car-mile, the car weighing 8.6 tons and having a traction coefficient of 12 pounds per ton, would be 544,000 foot-pounds, which leaves 1,526,000 foot-pounds as the energy expended per mile for lifting and accelerating, which is 74 per cent. of the total as against 26 per cent. for horizontal traction. These figures illustrate approximately the usual values for city work with moderate grades.

This shows the importance of utilizing as much as possible of the energy stored in the car in starting and in goingup-grade. Various methods have been suggested of either storing the surplus energy in accumulators or else throwing it back into the line. There is no system in commercial form at present, but there doubtless will be soon, as the importance of the subject warrants serious attention. If a saving of half of the energy stored in the car in being lifted and accelerated could be effected, it would amount to 763,000 foot-pounds per car-mile, or an equivalent of 287 watt-hours. On the basis of one cent per kilowatt-hour this would be .287 cents per car-mile and for a 10 mile trip would be 2.87 cents; for 15 trips, 43.1 cents per car per day, or $157 per car per year. For a 15-car road this would amount to $2,355 per year and for a 100-car road, $15,700, which at a capitalization of 5 per cent. would be equivalent to $47,100 and $314,000 respectively. Obviously, the saving in power-house machinery would be also very great.

A considerable saving can, however, be effected by allowing the cars to drift as much as it is practicable to do so, and starting the cars at a moderate acceleration, or whatever the controlling system was designed for. The current should only be on for the minimum time necessary and should be shut off as far ahead of a stop as the drifting will allow. In going down-hill no current should be used except for a moment in starting or for a short time when the grade is not steep enough to permit of drifting. In city work a mere acceleration up to a speed that will carry the car by drifting to the next stop is usually all that is necessary. In suburban work the current is required to be on for a greater length of time.

In brief, *the brakes should be used as little as possible and the car allow to drift as much as possible.* Care in this direction will result in a large saving of energy at the station, and care in starting cars will also result in a saving that is worth considering. Motormen in general use current as long as possible and produce all of the retardation with the brakes; many of them do not shut off the current until just as they put down the brakes, thus making practically no use of the stored energy. Frequently they only use two points of the controller in starting, namely, the third (series), and the tenth (parallel), regardless of the passengers and power-station. They sometimes put on the current in going down-hill when there is absolutely no necessity for it, and also put on the brakes while current is on and put on the current while the brakes are on. When behind time or running a "home" trip or "supper" trip the motormen will accelerate as rapidly as possible and these trips are therefore always expensive for the company.

The slight increase in the running time occasioned by more careful handling of the car will not affect the schedule of the average speed more than a few per cent., which will scarcely be noticed by the passengers, and will result in a considerable saving to the company.

In order to determine what difference would result in handling a car in a more careful way than is customary, some tests were made which gave interesting results. One of the motormen used was doing regular service on the road, and was, if anything, above the average ability; the other was one of the electrician's assistants, and carried out the instructions given to him for careful running; the same car was used in both tests, and the number of passengers carried and stops made were practically the same. The schedule time was adhered to very closely, and the motormen were not aware of the objects of the tests that were being made.

The difference in watt-hours used by the special motorman in the outgoing trip, which was mainly up-grade, was 85 per cent. of that used by the regular motorman; on the return trip, mainly down-grade, it was 74 per cent., which is a saving of 15 and 26 per cent. respectively on the outgoing and return trip or an average of 20 per cent. for the round trip. The difference on the down-grade was greater on account of the special motorman allowing his car to drift more than the other. The number of stops made was only about 8 or 10 for the entire trip of 14 miles, and, therefore, the manner of accelerating the car did not produce much effect on the result, and the difference can be said to be mainly due to more

drifting. This average saving of 20 per cent. produced by more careful operation is not a maximum, but in case it may be considered to be impracticable to produce so large a difference by means of a change of instructions to the ordinary motormen or employing a more intelligent class of men, half of that amount, or 10 per cent., can be considered a saving that could readily be effected.

Some calculations based on a saving of 10 per cent. may be of interest in showing its value. The cost of the energy affected by this saving may be assumed to be one cent per kilowatt-hour, which is much below the probable cost in average practice, but it is taken as a safe and possible figure. The gain that would result by using less power on the line will be computed on this basis. On a suburban road running 14 cars and making 14 trips a day the average watt-hours per car-mile for the day were found to be 1,167. The car and passengers averaged 15,700 pounds and the round trip was 10.12 miles. The average number of stops was 34 for the round trip. A saving of 10 per cent. of 1,167 watt-hours per car-mile, or 11,801 watt-hours per trip, at one cent per kilowatt-hour is 1.18 cents per trip, which amounts to 16.5 cents per car per day and $60.30 per car per year, or $844 per year for this one line. This road is partly suburban. Taking the average performance of city running on a 10-mile, 15-car, 15-trip road as 1,300 watt-hours per car-mile a 10 per cent. saving amounts to 1.3 cents per trip, 19.5 cents per car per day, $71.20 per car per year, and $1,067 per year for the entire road, or for a company operating 100 cars this amounts to over $7,000 per year. These figures may appear startling at first, but they are based upon data obtained from a large number of tests and under the conditions of actual service, and are by no means extreme or unusual values; they can be taken as very fair values and err in being too small rather than too large. The effect upon the schedule was very slight, not more than about two per cent., though for city work it might run as high as three or four per cent. when the number of stops is very great; but the slight increase of the running time to effect this saving would amply repay the company and would scarcely be noticed by the passengers.

This shows conclusively that the proper training of the motorman is a very important matter and should receive the earnest attention of every electric railway manager.

Stopping and Starting.—The difference between the energy used by a car running past a station and that used in stopping at the station in and starting again, was found to be about 85 watt-hours per stop from the average of about 100 tests. This amount varies from 75 to 100 according to the grade on which the car is stopping and the load it is carrying, but 85 is about the average for usual conditions. These tests were made by running the car over a road on which definite stopping places were designated, and a different number of stops made on successive trips, each trip being repeated for the same conditions until the readings agreed. The car was loaded with sand bags and weighed on car scales. A portable Thomson recording wattmeter and a Boyer speed recorder were placed on the car and records were kept of the watt-hours, time, stops and load for each half trip. The difference between the watt-hours required for a different number of stops enabled the watt-hours per stop to be determined.

Quite a large number of unnecessary stops are usually made by cars, especially in city work, and though the single losses are small in amount, the aggregate is considerable. For instance, on the same basis of one per cent. per kw-hour the cost of energy per stop amounts to .085 cent, nearly one tenth of a cent. At this rate the cost of making one extra or unnecessary stop on each trip would amount to 1.28 cents per car per day for 15 trips, $4.67 per car per year; for 15 cars, $70 per year, and for 100 cars $467 per year, merely for one extra stop per trip. To make a stop at a street crossing on a double-track road operating 30 cars making 15 round trips a day, the cost to the railway company for electrical energy alone would be 76 cents per day or $278 per year to stop their cars at this one place. This does not include the cost of brake shoes and wear and tear, nor the capital invested in the increased size of the power-house.

The question of reducing the number of unnecessary stops is therefore also one that should receive the attention of electric railway managers.

Increased Weight.—The additional amount of energy consumed by the car, due to an increase in weight, varies with the load, the number of stops, and the character of the roadway. It was found from a large number of tests made on a first-class road, that the average for a 20-stop, 20-passenger trip is about 20 watt-hours per ton-mile, one watt-hour per 100 pounds per mile, or 1.4 watt-hours per passenger-mile. A reduction in the weight of the car of 1,000 pounds amounts to a saving of 10 watt-hours per car-mile, and for 160 car-miles per day, a usual average, it would effect a saving of 1.6 kw-hours, which, at the rate of one cent per kw-hour, amounts to 1.6 cents per car per day, $5.84 per car per year, $87.60 for a 15-car road, and $584 for a 100-car road per year.

The paying load on city roads averages about 10 to 15 per cent. for the day, and a reduction of the weight of the car would obviously increase the per cent. of paying load; although heavy trucks are necessary for certain conditions, the subject of a minimum weight for cars, especially for light service, is an important one to be considered by electric railway managers.

Detailed data concerning some of these tests, as well as others made on electric cars, are given in a series of articles by the writer, at present appearing in the *Electric Railway Gazette.* The data concerning the variation of the watt-hours per stop, with different number of stops and different loads, and also the watt-hours per ton of load for different loads and number of stops, is not yet fully worked up, but the writer hopes to publish them at an early date.

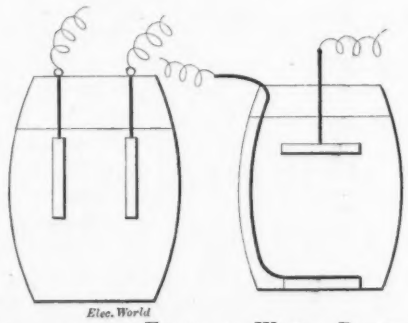
Water Rheostats.

BY GEO. T. HANCHETT.

Many practical men do not know how universally water resistance may be applied, both for temporary and permanent service, in electric lighting and power work. It is often the case that a resistance of some kind is greatly desirable, if not absolutely necessary, and a few practical suggestions concerning the use of water resistances in such cases may not be amiss.

The fluid in a water rheostat is not wholly water, as the name might imply, but consists of a mixture of water and some acid, usually sulphuric, which is added to vary the specific resistance. As the range obtainable by this procedure extends from one tenth of an ohm, or even less, to several thousand ohms, the flexibility of the device is obvious, and it is practicable to prepare a water resistance to suit any voltage by varying the degree of acidulation.

In the liquid are placed two metal terminal pieces, identical as to material, so as to obviate electrolytic action, and to these are attached the circuit wires. The proper shape and size of these terminals depend upon the volume of current to be passed through the device, and are also affected somewhat by the voltage. With large



Figs. 1 and 2.—Forms of Water Rheostats.

currents or very low voltage, or both, the terminals should be of large superficial area, and *vice versa.*

Water resistances are more often temporary devices, and, therefore, barrels, pails, etc., are frequently pressed into service. In cases where the apparatus is to be used for a few moments only, and the voltage is not dangerously high, a metal vessel is very convenient and satisfactory, the vessel itself constituting one terminal, and the other terminal being suspended therein. The resistance is decreased by gradually lowering the suspended terminal until it touches the bottom of the vessel, when the resistance is, of course, entirely cut out. However, it is not desirable to use any device in which the terminals tend to come together, except in cases like the one just mentioned, for the sudden removal of resistance from the circuit, caused by the accidental dropping of the suspended terminal, might result disastrously.

A water resistance may be adjusted either by varying the distance between the terminals or by varying the terminal area submerged.

The first method is preferable with heavy currents, and the second is better with small ones. The bulk of fluid necessarily depends upon the watts to be absorbed, regardless of voltage and current. For a steady load, free from sudden fluctuations, 20-kw per barrel of fluid will be found to be a very satisfactory working figure.

If a comparatively wide tank or tub is used, whereby a large surface of water is exposed as compared with its bulk, a higher figure may be taken.

The most satisfactory method of arranging a barrel of water for voltages under 220 is shown in Fig. 1. Rods are laid across the top of the barrel and the plates hung therefrom. The rods can readily be arranged to admit of the adjustment of the distances between the plates, and should one of the supports break it would not cause trouble by a short circuit.

Unfortunately, the arrangement shown in Fig. 2 does not possess

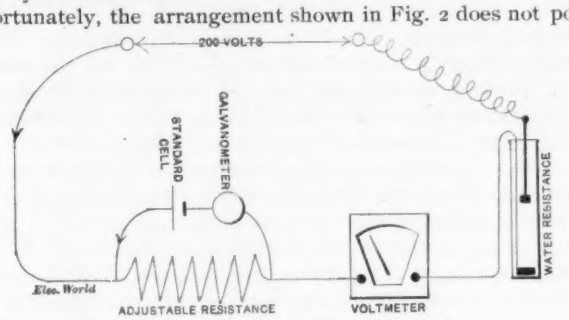


FIG. 3.—WATER RESISTANCE IN VOLTMETER-CALIBRATION.

this advantage, but, barring this feature, it is well adapted for voltage up to 500. For 1,000 volts two such barrels in series can be advantageously used.

For starting a motor it is surprising how small a rheostat (mechanically) will suffice. A 25-hp motor can readily be started under load with a water resistance contained in a two-quart pail, and a 5-hp motor can be handled with the resistance contained in an ordinary cup. In each case the starting will be perfectly smooth and free from sparking.

In using a rheostat of this type to control a shunt field circuit it is well to have it amply large mechanically, in order to avoid instability due to the excessive heat which would be produced by the use of too small a body of liquid.

In making up a water rheostat the acid should be poured in a very little at a time and the fluid thoroughly stirred.

If this is neglected the resistance of the liquid will later on suddenly decrease, it may be to a point that allows a dangerous current to flow.

Experiment is usually the better way to determine how much acid

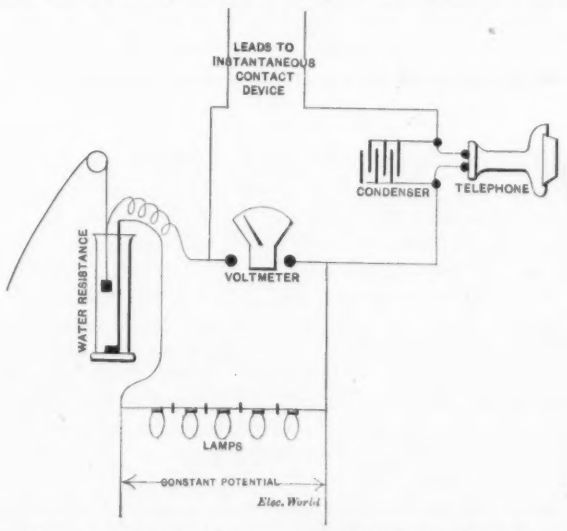


FIG. 4.—TAKING ALTERNATING-CURRENT CURVES.

is necessary, but for those who desire a guide to follow the accompanying table is given.

Resistance of a body of liquid one square foot in cross-section and one foot long:

Pure water			about 100 ohms.
.174 per cent.	acid		4.12 "
.435 "	"		1.75 "
.724 "	"		1.10 "
.985 "	"		.85 "

The proportion of acid should be sufficient to enable the solution to absorb about one third the desired energy. The rest can readily be obtained by the adjustment of plates. In some cases, where a high voltage and a very small current are involved, as in voltmeter circuits, a water rheostat in column form will be found to give satisfactory results. Unfortunately, water resistances are prone to develop annoying back E. M. Fs., which preclude accurate measurements. To avoid this as far as possible in voltmeter circuits use a solution of zinc sulphate and two zinc terminals; these produce a minimum back E. M. F. Fig. 3 shows the much-used method of calibrating a voltmeter with a standard cell, in which a water rheostat is almost invariably used. With a 30-inch column of solution 100 volts drop can be obtained with the usual voltmeter current passing.

In the method shown in Fig. 4, for taking alternating-current curves by instantaneous contact, in which a liquid rheostat is used,

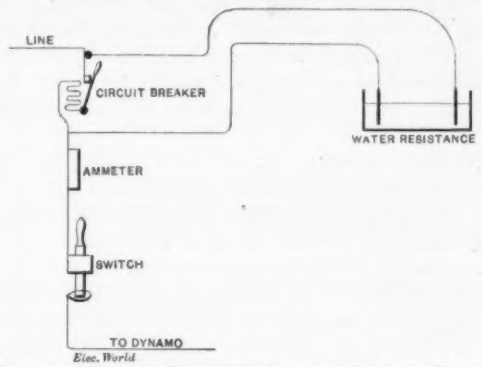


FIG. 5.—WATER RESISTANCE AS A SAFETY LOAD.

voltmeter readings to within $\frac{1}{10}$ volt can be obtained by two independent observers.

Fig. 5 illustrates diagrammatically an application of a water resistance to railway work. A rheostat capable of furnishing half-load to the dynamo is connected in shunt to the circuit-breaker, so that when the latter opens the arc is much reduced, and the load is not entirely taken off the dynamo and engine. This not only reduces wear and tear on the circuit-breaker, but may prevent a disastrous runaway.

The Rating and Behavior of Fuse Wires.

In a paper read before the American Institute of Electrical Engineers at its October meeting, Prof. W. M. Stine, H. E. Gaytes and C. E. Freeman give an account of some elaborate experiments on fuse wires made at Armour Institute, Chicago. In the experiments undertaken it was considered best to adopt not more than two brands of wire for all the tests, rather than to employ a large number of varieties; other investigations have shown that various makes of fuse wires closely resemble each other in behavior, and that the conclusions obtained with one wire may be accepted as true for all. In the first series of tests two classes of porcelain cut-outs were employed; one was an open porcelain or main line block and the other of the closed porcelain or K W type. In the latter, which has recently been very properly condemned by the underwriters, the ten-ampere size has a space of only one-half an inch between the terminals, and a fuse blowing under twenty amperes invariably establishes a vicious arc accompanied by such an explosive violence as to frequently shatter the block. The terminals of the open block are further apart, but a pronounced fault in their construction is that the terminals are let in flush with the surface of the porcelain. In nearly all types of porcelain fuse blocks the terminals are too close together in small sizes, the fuse often rests on the top or base, and the mechanical construction is very poor. The tests with the above two types showed their unreliability and also demonstrated the imperfect rating of one of the two fuse wires used. In a second series of tests an open eight-inch fuse block was adopted to avoid all cooling effects from the terminals. The tests showed a great variation in the time of blowing.

The blowing of a fuse is stated to be not immediately an electrical act. The current fuses the metal, the cross-section is reduced at some point due to gravity, unequal expansion and sweating; the heat in consequence intensifies at this point and a globule falls, breaking the circuit and establishing an arc which soon burns out the fuse.

It was found that fuse wire of small diameter more nearly approaches the ideal condition, and recommended that to guard against excessive currents of short duration such as motors are subject to when operated on street railway and power circuits, multiple fuses be used; a fuse of four pieces of five amperes each would, for example, prove two or three times as sensitive as one piece of 20 amperes. As the sluggishness of large fuse wires may be due to the action of the outer layers, which, with the oxide coating, prevents the fuse from breaking, a thin ribbon should prove more sensitive than a round wire.

Tests with long lengths of wire revealed some actions which may account for the lowering of the fuse point by use. In one wire, with

the current just below the fusing point, the fuse was found to "sweat" and the oxide film broke in places to allow the molten interior to ooze out. When the current was shut off, the globules were drawn in, leaving the wire pitted. A second fuse wire was found to be remarkably plastic and free from an oxide film, but it sagged badly and twisted, showing a high coefficient of expansion; as a result it was drawn out and the cross-section reduced. When used vertically the metal floated until a large globule formed, a rupture occurring just above this. In the case of German silver fuses, the sweating resulted in partially breaking up the alloy, the zinc seeming to melt out from the nickel and fusing with the copper, forming globules of brass. This was so marked that it would render such fuses too uncertain for use in all but the smallest diameters of wires.

The experiments showed that the usual rating of fuse wires in ampere-carrying capacity is practically valueless and should be discontinued. The proper designation for such wires would be a table of carrying capacities for the lengths ordinarily employed. For example, a ten-ampere wire 8 inches long fused in 30 seconds, with 15 amperes; with 35 amperes in a length of one half inch in a covered fuse block; and with 25 amperes in an open block with a length of ⅞ of an inch. Accompanying each spool of one of the wires was a stated carrying capacity for a given length, but this is not sufficient, for it furnishes no guide for other lengths.

Copper fuses were found to be more sensitive than alloy fuses; in the tests they reached a red and even white heat, while the other fuse wires scarcely reached a perceptible glow. Metals in general which can be worked to a nearly white heat will prove more sensitive, since the slight increase of heat will make them highly fluid, and ruptures will promptly occur; the practice, therefore, of using copper in street railway circuits for limiting the fuses seems justifiable. The tests in general showed the desirability of working fuses at a red heat for normal maximum loads, but this is declared to be a question that must eventually be left for the underwriters. German silver was found to offer no advantages in large sizes and it deteriorated more rapidly than any wire tested. A copper fuse enclosed in a fibre tube is recommended for electric lighting and power circuits.

In testing the influence of fatigue on a wire, long lengths of two different fuse wires had a current passed through them for seven hours, and it was found that one experienced a positive and the other a negative fatigue. It was found that nothing was gained by cleaning fuse wires, but rather that the thin film of grease deposited during the drawing of wire was rather an advantage. It is added, however, that some coating not affected by heat and reducing radiation, would doubtless increase the stability and sensitiveness of fuse wires.

A singular phenomenon was noticed when eight-inch test pieces of one of the wires were blown horizontally in a test block. The arc would usually occur at the same place near the centre of the fuse, and when the time was within six seconds the entire piece would be shattered into approximately equal lengths, varying from ¾ to ⅞ of an inch according to the current employed. The length of these pieces varied with the strength of the current, and the uniformity of the results was noticed throughout the tests. The entire fuse to within a short distance of the terminal seemed to explode into fragments, simultaneously with the formation of the arc. Practical conclusions of the tests are given as follows:

1. Covered fuses are more sensitive than open ones. 2. Fuse wire should be rated for its carrying capacity for the ordinary lengths employed. 2. When fusing a circuit, the distance between the terminals should be considered. 3. On important circuits, fuses should be frequently renewed. 4. The inertia of a fuse for high currents must be considered when protecting special devices. 5. Fuses should be operated under normal conditions to insure certainty of results. 6. Fuses up to 5 amperes should be at least 1½ inches long, one half inch to be added for each increment of five amperes capacity. 7. Round fuse wire should not be employed in excess of 30 amperes capacity. For higher currents flat ribbons exceeding four inches in length should be employed.

DISCUSSION.

Dr. Emery expressed the opinion that copper was much the best material for fuse wire, and advocated covered fuses as preferable to those exposed, calling attention to the satisfactory performance of the device used by the Westinghouse Company for street cars, which embodies the features mentioned. He also pointed out that a convenient rule of thumb for rating copper wire as fuse wire was to divide the carrying capacity by two for every third size of wire going up the scale; the capacity of No. 13 wire being about 100 amperes, No. 16 would carry 50; No. 19 would carry 25, and so on.

Mr. Kennelly did not agree with Dr. Emery as to the advisability of using copper wire for fuses, and also criticised the statement in the paper to the effect that a covered fuse is more sensitive than one uncovered. He said it depended upon what constituted sensitiveness; if it was meant that a covered fuse would blow within a smaller margin of overload, then the statement might be correct; if, on the other hand, the sensitiveness was measured in time margin, then the covered fuse is less sensitive, for the reason that the surrounding material radiates the heat and prevents the fuse from attaining a melting temperature as quickly as an uncovered fuse would. He also stated that a very great difficulty with fuses is that no two men use a fuse just alike. In some cases it is desired that the fuse shall blow promptly under a small percentage of overload, and in others it is not expected to blow unless subjected to an enormous excess of current. The only way to obtain unity of rating, he said, is to state how the fuse is to be used. He agreed that copper was very convenient, but opposed its use on the ground that if it was desired to have a sensitive fuse that would blow at a small margin of overload, it would have to be run red hot under normal conditions.

The chair, in the absence of the authors of the paper, explained that the covered fuses referred to were not in contact with metal except at the ends, and that in many cases there was an air-space of one-half all around the fuse wire; Mr. Kennelly said that this explanation overcame his objection as to the sensitiveness.

Mr. Wolcott thought conclusion three in the paper was a very important one; fuses should be changed frequently on important circuits, particularly if they are steadily run up to their rated capacity.

Mr. Wm. Stanley, Jr., expressed his preference for copper fuse wire and mentioned having noticed that one portion of an alloy fuse would sometimes be almost reduced to liquid form while the remainder of the same piece of metal was apparently unaffected, indicating an inequality in the material which was not present in copper wire. He had found the latter much more reliable than any alloy fuse. Mr. Stanley said also that he had found it good practice to enclose a fuse in a glass tube and fill the tube with sand or brick-dust. The result was that after a fuse blew there was nothing left behind; it was just as though it had evaporated. After some further discussion by Messrs. Howell, Kennelly, Crocker, Emery and Stanley the meeting adjourned.

The Invention of the Electromagnetic Telegraph—VII.*

BY STEPHEN VAIL.

While I am quite willing to leave the article of this series, bearing the signature of J. D. Reid, as a whole, without comment, to the unbiased and genuine truth-seeker, who will, if he knows anything whatever about the *real* history of the invention, recognize that the *facts omitted far outnumber those stated*, I desire to call attention to a few of the many exceptions I might take to it. I do not believe that Alfred Vail's genius, his ability or his high character as a Christian gentleman and a citizen, can be injured by anything that Mr. J. D. Reid may write or say of him. The remarks of the Hon. Amos Kendall, elsewhere given, will, in the minds of all honest men, counteract any effect which might otherwise be produced through the animus that dictated the low-toned and untruthful remarks of a personal nature made by Mr. J. D. Reid.

I would like to ask Mr. Reid why, in his allusion to the meeting of my father and Morse, on Sept. 2, 1837, and their subsequent removal to Morristown, he so pointedly avoids any mention of the formal contract, signed, sealed and delivered between them on the 23d day of September, just three weeks later? The only statement he makes is that my father "assured Morse that facilities would be given him to have the apparatus put in condition for public use," the intention of Reid being to give the impression that the association was based upon verbal expressions. Mr. Reid writes thus: "By the year 1844, the Morse Patent became the property of four parties, Dr. L. D. Gale, Alfred Vail, S. F. B. Morse and F. O. J. Smith. To Mr. Vail was assigned one-quarter . . . . . *The chief reason for this grant* was that *he had introduced into the register* what Morse called the *point seche*, or *steel stylus*. . . ." Is this not a remarkable statement for a "truthful" historian to make, when by reference to the contract signed by my father and Morse in September, 1837, *seven years before*, it will be seen that

*Continued from page 496.

Alfred Vail was to receive one-quarter interest in the patent for money and services to be at once rendered, and which were furnished immediately?

This veracious historian, in stating that at the time Alfred Vail joined Morse, he was without any special engagement of any kind, either wilfully misstates or is ignorant, for at the time Alfred Vail saw Morse's experiment, on Sept. 2, 1837, he was at the University of the City of New York, in pursuance of his studies for the ministry, the profession he had decided upon following. Alfred Vail was a young man of about thirty, Morse a man of nearly fifty years of age, at the time they entered into partnership, and is it very strange that, *a few months later*, when the prospects of the great success of the invention were most flattering, my father should write to his much older companion, and the one through whom he had become interested, expressing his thanks and indebtedness to Morse? No, that was not at all strange. It is strange, however, that Mr. J. D. Reid should cite the letter referred to in such connection as to make it appear to have been written (*as the date is omitted*) many years later than it actually was. The fact is the letter was written on the 19th of March, 1838, while Mr. Reid has so placed it in sequence to another letter and other matter, as to make it appear to have been written *subsequent* to September, 1848.

Alfred Vail died almost twenty-one years after that letter was written by him, and there would seem to have been time enough in the meanwhile (when all that occurred during that time is considered) for him to have formed some other opinion of Morse.

"As to what Mr. Pope is pleased to call 'the grandeur of Mr. Vail's conception of an alphabetical code, based upon the elements of time and space,' the assertion of which, as the invention of Alfred Vail, is based on the memory of a boy of fifteen, after the lapse of fifty years. I have this to say, etc., etc.—this boy, Baxter, *thought* that Mr. Vail was inventing a new alphabet, etc."

This quotation from the article of this series by Mr. J. D. Reid, suggests that he is possessed of a power peculiarly his alone, for, while we are in this day more or less accustomed to hear of alleged mind reading, it is never performed without the subject's mind being in activity at the moment. Here, however, is a man imbued with the wonderful power of reading (at the present time) the thoughts conceived in a mind nearly sixty years ago! I must confess to my inability to cope with such a power.

Still, Mr. Baxter, in his written history of the invention, makes his statements with force; Alfred Vail frequently made the same claims to his family and friends, *as I personally have heard him;* his uncle so claimed in his article in *Hours at Home;* Mr. M. S. Beach so stated most positively in the *Sun* in 1858; and so have many writers since, that Alfred Vail's genius alone produced the dot-and-dash alphabet.

Such perversion of facts and evident intent to manufacture sentiment by false statements, so characterizes the entire article of Mr. J. D. Reid that I decline to further consider it, and to waste no more space upon it, only requesting the reader to weigh well the words and assertions of one, who, professing to be an "historian of the telegraph," can boldly assert with the terms of the contract between Alfred Vail and S. F. B. Morse still in existence, that "Alfred Vail simply hired himself at three dollars per day to put into mechanical shape the *already completed* Morse telegraph."

Mr. E. L. Morse, in his article of this series, makes this inquiry:

"But if Vail did invent so much of the telegraph apparatus as is claimed for him, why did he not assert his rights? The peaceful unity of the invention could have been preserved under the joint names of Morse and Vail."

Is it not somewhat singular that Mr. Morse should, while professing to be familiar with the status of affairs during the long period of litigation, propound such a question?

Partners deeply immersed in legal action against infringers of patents owned jointly by them, would naturally be disinclined to take any step whatever likely to be detrimental to their interests, and what could be more so than a question arising between themselves and given publicity, questioning the sworn statement of the one in whose name the patents were taken out? In addition to the above very sufficient reason, Alfred Vail was absolutely debarred by the terms of his contract from taking out patents in his own name, for anything he might invent connected with the telegraph.

Mr. E. L. Morse is probably not aware that legal complications respecting infringement of the patent began very soon after the first line demonstrated the telegraph to be a practical success, and it was not until after this time that Alfred Vail fully realized to what an extent that success was in reality due to his individual efforts, and also to what an extent his name and part in the invention was being eliminated by Morse as rapidly and completely as possible.

It is true that in the years 1858–59, intelligence of events occurring throughout the world, was not as widely diffused as at present, but to that condition of affairs can only, by a generous stretch of the imagination, be attributed the fact that S. F. B. Morse never called into question the truth of the statement (made by Mr. Moses S. Beach, in his editorial in the New York *Sun*, of Sept. 25, 1858), that Alfred Vail was the inventor of the dot-and-dash alphabet, as well as other portions of the system, so-called the "Morse Telegraph."

The New York *Sun*, was, next to the *Herald*, the leading journal of the city, and it would seem to have been an impossibility for so prominent an article to appear in it, without meeting the eyes or ears of some of Morse's numerous family or friends, who must then have known of this statement, which so seriously questioned the status of Morse, posing as he was as the great inventor he claimed to be.

The fact remains, however, that Morse never refuted that statement nor the other made by Dr. W. P. Vail, an uncle of Alfred Vail's, in an article in Scribner's *Hours at Home*, September, 1869, *which latter appeared when Morse was not absent from this country.*

That article contained this passage:

"The birth-place and the birth-time of the telegraph, as a recording instrument of intelligence, . . . the parties who wrought the rude original plan into working order, and gave it efficiency, *the man who invented the 'Morse alphabet'* (so-called), and to whose ingenuity, mechanical skill and perseverance the clockwork of the telegraph machine is largely due, . . . all this is well understood, and, for the most part, is written down, and the record some day in the near future must find its place in history, upon the true principle of *suum cuique.*"

Dr. W. P. Vail, in response to an inquiry as to Alfred Vail's invention of the dot-and-dash alphabet, wrote:

"It was so understood by all who were admitted to his intimacy. In conversation with him shortly before his death in 1850, he so assured me. I am not aware that Mr. Morse ever set up an adverse claim."

In referring to these statements of Dr. W. P. Vail, Mr. E. L. Morse passes them by, with the remark that "an uncle of Alfred Vail *hints* that his nephew invented the Morse alphabet." If these constitute a *hint* only, what does Mr. E. L. Morse require for a positive statement?

The use by Mr. J. D. Reid of the word "prior" instead of "subsequent" is so palpably a mistake, that any one *honestly discussing* this question would pass it by unnoticed. Mr. E. L. Morse perhaps believes his own statement that his father "never troubled himself much about the claims made, not by, but for Alfred Vail, because he thought it unnecessary, etc., etc.," but I think such an argument will carry little weight with those who know what S. F. B. Morse said to the widow of Alfred Vail, when, one month before the date he died, he produced a pamphlet (referred to elsewhere in this article), and told her that "it had made him sick."

Mr. E. L. Morse very characteristically does *not* state, when referring to a communication sent by me to the *Evening Post* (and refused publication, with the proverbial discourtesy of that sheet), that it was a refutation of a slanderous communication printed in that paper, over the signature of a member of S. F. B. Morse's family, in which I was characterized as being untruthful and ungrateful to S. F. B. Morse (why I should be grateful to him, I know not), and false in statements respecting my father. Mr. E. L. Morse took particular pains to omit any mention of that letter, and his statement that I sent signed copies to the members of Morse's family is false, for but one copy was sent, and that to the writer of the communication which drew it forth.

I fail to see wherein my quotations from the speech of Mr. S. F. B. Morse, at the Academy of Music, can be characterized as a "deliberate misquotation in order to bolster up my cause," although I must confess to a wrong mention of the *locality* and *time* when it was uttered, for I find it was not at the Academy of Music, on the 10th of June, 1871, but at the banquet given to Morse at Delmonico's, on the night of the 29th of December, 1868, that he made use of the words, "furnished the means." If the use of the same terms, with the addition of the words "and mechanical skill," on the former occasion referred to above, can be believed to absolve Morse from the charge made by the friends of Alfred Vail that he intentionally and absolutely ignored the real status of the latter in connection with

the invention of the telegraph, Morse's satellites are welcome to the thought.

The letter written to Morse by my brother, Mr. J. Cummings Vail, and quoted by Mr. J. D. Reid with so much parade, was to my knowledge written only in sarcasm, and was sent to Morse in opposition to the wishes of the rest of Alfred Vail's family. It was impossible for him, or any one else having the knowledge he had of his father's treatment by Morse, to have written such a letter in any other way than that of sarcasm.

The following extracts from private letters written by Mr. F. O. J. Smith, to a gentleman interested in the subject under discussion, may not be uninteresting, and to them is added one from Mr. Henry O'Reilly (who needs no introduction to the telegraphic world), also addressed to the same gentleman:

"March 20, 1872.

"I found much in Mr. Vail's papers that can be criticised in doing his memory justice in respect to the telegraph and to correct history—much more than Prof. Morse will want to see, and it is possible that with more time I could have found still more of interest. But I have enough to establish the ascendancy of Mr. Vail's genius over that of Morse, in the creation of the telegraph.

"In respect to the letter of Prof. Morse to the attorney-general, it was written by me, as his counsel, under his dictation, while we were in London seeking a patent. It is the original I have, interlined on each page by Prof. Morse, so authenticated beyond denial. He made a copy, which he sent to the attorney-general, with a view of inducing the latter to reconsider the adverse decision he had made on the Morse claim, and setting out all the peculiarities of the *then* invention, as it had been perfected, and constructing the published and unpublished descriptions of it, claiming that the latter were the life and soul of the invention, and without which more than half its usefulness would be destroyed, etc."

"Rutland, Oct. 12, 1871.

". . . When original and authentic documents shall come to the public eye, the world will be astonished at the humbuggery that has been practised from sordid motives, principally by the instrumentalities of the . . . , in and with the name of Prof. Morse, as inventor of the telegraph. One single letter addressed by him to the British attorney-general in 1838, of which I have the original draft, will prove, beyond the possibility of refutation, that, down to that period, *he* had never invented and knew not how to organize the necessary mechanism of a practically useful telegraph.

"Then, that which he regarded as the prime necessity of such telegraph, as he had up to that time invented, was soon after abandoned as utterly worthless and was never thought of afterward for use."

"March 22, 1872.

". . . I did find some more important revelations at Morristown—a positive assertion of Mr. Vail (in a letter to Kendall) of his invention of the roller groove and steel point, for which he said he never had a public recognition, *Kendall implored him to suppress the facts*, AS THE PATENTS AND ALL PROPERTY UNDER THEM WOULD BE DESTROYED."

"March 9, 1872.

". . . It is high time that one of the most monstrous humbugs and frauds of the age should be thoroughly blown up, and your article does it in a way that will command the more attention the more it is read by intelligent and scientific men and practical telegraphers. The ball is opened and the result will show how nobly you have led off in the dance."

"Portland, Me., Oct. 19. 1871

"L. W. C., *Dear Sir:* In further answer to your letters, I will remark that the public has hitherto not known that Prof. Morse's patented invention has in itself this history:

"On board the *Sully* in 1832, the conception, in conversation with Dr. Jackson, seized upon his mind that it was feasible to render electricity available as a telegraph by making Franklin's idea of rendering electricity visible at a distance, the basis of an alphabetic system of numbers, and those numbers the signs of words. He was to do this by decomposing with the electric current, some substance thereafter to be found out by Dr. Jackson and himself, into dots, or burnt spots. The digits were to be represented by dots, thus (·) to represent the figure 1; ·· to represent the figure 2; ··· to represent the figure 3; and so on up to 10. These figures were to represent words in a dictionary numbered to correspond.

"He made a draft on board the *Sully* of the apparatus he would use in thus marking his dots on paper by electrochemical decomposition of the substance theaeafter to be found out. It consisted of a frame holding a triangular inner frame which was to hold the terminus of the electric wire in contact with paper drawn by clockwork beneath the point. To break and close the circuit, he invented the saw-teeth type which were never reduced to use and were needless.

"All these parts he made diagrams of in his "sketch book." His idea was to pass a current along the wire to a point in contact with the moving paper, saturated with something which might, by decomposition, either make a discoloration on the paper or burn a hole in it answering to a dot, as often as the current should pass, and decompose or burn as long as the current should pass, and cease on the breaking of the current.

"Beyond this his idea was never perfected on board the *Sully*. He then knew nothing about a battery or magnet. He then proceeded upon the theory that a current could be generated and broken, as Franklin had done it, and as was already known to science, although the modus was not known to himself. He knew that Franklin had made electricity instantly visible at a great distance, and that agency so known to Franklin was his proposed agent. He thought that Franklin failed to make a telegraph because he had no alphabet.

"It was agreed between himself and Dr. Jackson that they would, on landing, make experiments to determine what compound or salt would accomplish the burning or decomposition essential to make the dots on saturated paper. On landing he proceeded to cast his lead type, and then awaited Jackson's aid for a decomposing substance and to arrange the electric mechanism contemplated. But Jackson never did his part, and for five years the idea slumbered without progress in the brain of each.

"In 1837, five years later, Europe was in a blaze on the subject of an electric and of an electromagnetic telegraph. Of the former facts, read the correspondence between Morse and Jackson; of the latter fact, read the report of the Franklin Institute of Philadelphia, annexed to my report at the House of Representatives in 1838, and copied into Mr. Vail's book. This gave a new spice to Morse's old 1832 conception and to regret over Jackson's neglect to tell him of the needful decomposing salt. Electromagnetism then entered his mind as an available motive power that was being resorted to in Europe for a telegraph.

"He then thought of a change of his stationary triangular inner frame, into a swinging frame within the outer frame. He, therefore, suspended it by a hinge, with a view to making it vibrate like a pendulum by being drawn to one side by magnetic power and back to a central point by a counterpoising weight, when the magnetic power was withdrawn, and instead of extending the wire to the bottom of this triangular pendulum, so as to be in contact with the moving paper, he substituted a pencil at that point, which would mark on the paper as it moved forward an angular, lateral mark thus, WWW, and if the lateral motion ceased for any given time, the drawn paper would receive a straight or longitudinal mark, instead of the lateral mark, and of length according to the duration of such cessation in the lateral motion. This was the second stage of Morse's invention, the first proving abortive, from want of chemical and scientific knowledge.

"In the Spring of 1837 he got this triangular pendulum into the crude form stated, requiring an abandonment of the alphabet of dots, and substituting the points of the V-shaped character therefor. The idea was vivid to his mind as a mechanical success, and yet he lacked the knowledge to make a battery and how to make a magnet, the two indispensable essentials to his mechanism. It was in this stage in the Spring of 1837, Dr. Gale, having moved into quarters as a chemical professor in the New York City University, was invited by Morse to view his conception. Dr. Gale, on viewing it and seeing that Morse could produce no effect even through 40 feet of wire, with the battery of one cup, which he replied upon, nor with such a magnet as he relied on, immediately informed the professor wherein his lack of knowledge of both electricity or galvanism and magnetism in the modes he was employing them caused a failure of all his mechanical conceptions. He, therefore, referred Morse to Prof. Henry's publications of the true principles of both sciences, galvanism and magnetism, as published in *Silliman's Journal* many years previously, and Gale then aided Morse with the needful structure of both a battery and a magnet that would work out his conceptions of a telegraph. The thing was then accomplished, so that in the September following he had his type, port-rule and battery and magnet and vibrating pendulum in complete order to mark his V-shaped alphabet for designating numbers, and the design of a dictionary of words denoted by such numbers, and a theory of an electromagnetic telegraph reduced to actual operation for exhibition to others, though, as pronounced by the Philadelphia Franklin Institute, in even a third step of transformation from his conception on the *Sully*, not commercially useful.

"The Jackson correspondence will tell of Morse's ignorance of how to make a battery and a magnet in 1832, and from which ignorance he had made but little progress down to the Spring of 1837, when Gale first enlightened him from Henry, as to these essential elements of a telegraph. In Gale's depositions in the telegraph suits, he did not tell the whole story of Morse's ignorance, and through which he was as far from inventing a telegraph as Barlow was in 1829, when he pronounced it impracticable, not knowing the principles subsequently discovered, and first discovered by Prof. Henry and announced to the world in *Silliman's Journal*.

"But, in the conflict of Morse with Henry, in later years, Dr. Gale told the whole story, and it will be found so plain that a blind man may read it by the sense of touch. In the *Journal of Commerce* of September, 1837, you will find that the Morse lateral pendulum had no dot and no separate marks in its alphabet, and it was incapable of marking but one character shaped like V or W, clearly proving that such a telegraph as now exists, and such an alphabet, dispensing with an agency of numerals and dictionary, had not, up to that time, been invented by Morse.

"What a humbug, then, are all his pretensions of his invention as now claimed, as being an invention of 1832, on board the *Sully*? Between September, 1837, and Morse's exhibition to Congress in February, 1838, although the clumsy type and port-rule and cogged wheel apparatus for breaking and closing the circuit were still desired essentials, the other part of the mechanism was wholly transformed

from the vibrating pendulum to straighter levers, and the pencil had given way to the fountain pen, as the turning wire had previously given way to the pencil, and a new alphabet of dots and spaces, the same as Dr. Swain had many years before published to the world as a 'mural' telegraph alphabet, consisting of longitudinal marks and dots and spaces, had taken the place of the saw-teeth characters, and the whole thing had substantially undergone a new birth and radical transformation. The machine would no more make the saw-teeth characters than the machine that made them was supposed by Morse to be incapable of making dots and marks.

"This last transformation was under the plastic, manufacturing, mechanical mind of the Professor's associate, Vail, and Prof. Gale's close study of the enterprise. This was a third stage in the progress of the telegraphic invention, and in no feature of it was reflected one solitary thought of Morse, not suggested many years before, and by the savants of two centuries and two hemispheres. Truthful history will yet elaborate these exposures of Morse's baseless pretensions as an inventor, and with proofs as clear and incontrovertible as the silvery light of stars in the firmament of heaven. The humbuggery practised upon the world, in the name of Morse, through medals and decorations of honor, from rulers in the old world, wholly ignorant of the true history of the invention as the public was, will pass into ridicule, and statues of metal erected under the impulses of the same humbuggery by interested speculators, will become as transparent and ludicrous as the skeleton of a sprawling grasshopper, which has lived through a solitary summer.

"But yet another stage in the progress of this invention became needful—the fountain pen was a failure, the pencil was not sure to make dots, and then came the pointed metal stylus, that would emboss the signs by depressing them upon the paper, and the slight magnetic force to accomplish it was reduced from the magnet and coil weighing 150 pounds, as seen by Shaffner in the opening of the first line at Baltimore and Washington in 1844, to a magnet of a pound or two devised by Prof. Page, and still later to a magnet and coils of only a few ounces, found by Morse in Paris, and the mechanism of from four to six cubic feet in size, was, by Morse's sight-seeing in England and France, reduced to the size of ten inches by four.

"But the world will look in vain for one footprint made by Morse in all the successive journeyings of this great agency, except to gather up in combination the inventions and thoughts of others, and thus truly did Prof. Henry in his forced examination by Chief Justice Chase in one of the telegraph suits, testify:

"'I am not aware that Mr. Morse ever made a single original discovery in electricity or magnetism or electromagnetism, applicable to the invention of the telegraph. I have always considered his merit to consist in embracing and applying the *discoveries of others*, of a particular process for telegraphing purposes. I have no means of determining how far the invention is original with himself, when much is due to those associated with him.

"'As late as May, 1839, after his return from Europe, he published a reply to an article which had appeared in the Boston *Post*, in which he says: "Any one acquainted with my machine knows very well that it did not require my profound knowledge of these sciences (chemistry and electromagnetism) to invent it. I needed to know only such facts as are contained in the elementary treatises on these sciences. Any one acquainted with my invention knows that its merits are entirely mechanical." So in Morse's letter to Dr. Jackson, Dec. 7, 1837, he says: "The single scientific fact ascertained by Franklin, that electricity can be made to travel on a conductor any distance instantaneously, is all that I needed to know as to mathematical and mechanical science in order to plan all I invented on the ship, as any one will be able to see from a moment's inspection of my machinery as then planned.'"

"The unpretentious claims of Professor Morse were not swollen into their present proportions as enunciated by him at the Delmonico banquet until he had felt out the ignorance of the world as to the real history of the telegraph.

"So silently, and little by little, did he gather up other men's thoughts and knowledge essential to a practical telegraph, that the busy world around kept no trace of its progress, and slowly and imperceptibly did the professor monopolize the whole of science and mechanism, which it conbines, as his own original invention. But true history will disabuse the world of its erroneous impressions and accord justice to those who more deserve it. Yours truly, F. O. J. SMITH."

"NEW YORK, Feb. 12, 1872.

". . . . *Dear Sir:* I look anxiously to see your publication, which you say is nearly ready; never was greater fraud or humbug about any 'invention' or 'patents' than these which surround the Morse pretention. When Mr. Vail's papers can be seen, I doubt not you or Mr. Smith will be able to drive the last nail. Some others of the letters of Morse to Dr. Jackson, of Boston, in early days, add much to the force of what Mr. Smith quotes. I had these letters printed 24 years ago, and will try to find a copy to send you.

"Yours respectfully,

"HENRY O'REILLY."

At a meeting of the Directors of the American Telegraph Company in Philadelphia, to take appropriate action upon the loss of one of their number, many expressions of sorrow, sympathy and honor were made. Mr. B. B. French said:

"To him, Alfred Vail, the telegraph interests of America owe much, and it is the duty of all engaged in this now immense and vastly important enterprise, to pay to his memory a tribute of respect for *honesty of purpose, industry* and *perseverance*; in whatever he undertook, Mr. Vail was *surpassed by none*, and in *mechanical ingenuity* by *few*.

The Hon. Amos Kendall, ex-Postmaster General, in seconding the resolution, said:

"*Mr. Vail was one of the most honest and most scrupulously conscientious men with whom it has ever been my fortune to be associated. To him was Prof. Morse indebted, not only for means and assistance, but for valuable suggestions in bringing his telegraph to perfection, and if justice be done, the name of Alfred Vail will forever stand associated with that of S. F. B. Morse, in the history of the invention and introduction into public use of the electro magnetic telegraph.*"

An anonymous lover of justice has thus written:

"The name of Morse has been honored and become famous in every land. Decorations and honors were showered upon him by kings and potentates. His grateful countrymen held him in veneration and erected a bronze statue in his honor in Central Park, New York, while he was yet living." (A very general impression prevailed at the time that this was the work of the Western Union Telegraph Company). "This was right and proper. But it was not right and proper for the modest, unassuming inventor, of Morristown, whose inventive genius and mechanical skill produced that instrument that sent the message, the instrument that received it, and the alphabet in which it was sent, to be ignored and left in obscurity.

'Justice is sometimes tardy, but the facts in this case are becoming known, and the time is not far distant when full justice will be done to the memory of Alfred Vail. Monuments and statues are going up all over the land to heroes, poets, inventors and great leaders in all walks of life. Some day a great national monument will rise, on which the name of Alfred Vail will stand side by side with that of Morse, honored, equal and imperishable."

Without drawing further upon the many authentic sources of information in support of my claims for my father, Afred Vail, the very able and convincing article of the late Mr. F. L. Pope, of this series, making it unnecessary, I will leave the decision of this subject to individual minds, knowing full well, however, that *biased* and long-continued impressions are extremely difficult to up-root, and that consequently, of the comparatively few caring at all as to who was the inventor of the telegraph (or any other great aid to civilization and comfort), many will decline to change their opinions and beliefs, and the subject, long undecided, will remain so.

It, however, seems to me, in view of the facts clearly proven, that the telegraph of to-day (and as it has been since Alfred Vail joined Morse), contains none of the parts for which Morse claimed his foundation patent, and in view of the other fact that Morse was willing to claim anything, whether his own invention or not, as the courts fully proved, doubt is properly cast upon every claim on his part to having had anything whatever to do with the invention from the time that Alfred Vail became his partner, for his (Morse's) work had previously found complete development in his crude wooden instrument and vocabulary, which were cast aside as impracticable and commercially worthless by Alfred Vail.

A strong sense of the injustice done my father (not only by Morse, but by many writers on the subject of the invention) has caused within me a profound feeling of desire to properly place the great part taken by him in the development of the telegraph, before the world, and while I shall probably be characterized as bitter and unkind in some of my allusions, the truth needs no apologist, in this instance at least, for he who assumes to be what he is not, has only himself to blame if his disguise is eventually torn from him and his real character and claims be thoroughly exposed.

As indicative of an existing condition fully recognized by both my father and Morse, is any more evidence required than the statement of the former, so often made: "I am confident that Prof. Morse will yet do me justice," and the death-bed assertion of the latter (but unfulfilled), "The one thing I want to do now is justice to Mr. Vail?"

In Mr. Tanner's contribution to the "Invention of the Telegraph" series, which appeared in our issue of Sept. 28, about the middle of the second column, on page 344, read: "*Arago*, in his 'Oeuvres Completes,'" instead of *Amyot*.

In the article of Mr. Stephen Vail, in the same series, on page 471 of the issue of Oct. 26, in the sentence at the end of the second from the last paragraph of the article, three words have been omitted. The sentence should read as follows: "As these elements, together with a wire and an electric current, neither of which Morse ever claimed to have invented (so far as I am informed), *constitute the telegraph*, what was left for him to contribute but the suggestion embodied in his now discarded wooden apparatus?" The portrait of Hon. Stephen Vail, in the issue of last week, it should perhaps be explained, is not of the writer of the article, but the father of Alfred Vail.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Paralleling of Compound Dynamos.—In the Lond. "Elec. Rev.," Oct. 18, Mr. Pigg points out some features which may not be generally understood. The theoretical conditions under which two such dynamos are usually considered as giving out equal currents to a common pair of bus bars are that the ratio of the fall of potential in the armature, series winding and cable connections, of one of them, compared with that of the other, must be equal to the ratio of the resistances, including that of the armature, series winding and cable connections, for each machine. Under these conditions they would run perfectly in parallel, but the arrangement is not stable, and any variation in one of the quantities might result in one of the machines carrying all the load and driving the other as a motor; it is therefore customary to connect the positive brushes by means of a cable, the low resistance of which insures against the polarity of either machine being reversed by current from the bus bars, but it does not completely insure against one of the machines being driven as a motor by a current passing through the special brush connections. The use of these brush connections makes the above-mentioned relation applicable only if the two armature resistances and the two series windings and cable connection resistance are equal, the conditions being such that no current passes between the machines. He considers the case in which the armature resistance of one is greater than that of the other, the other resistances being equal and that the armatures are delivering equal currents and he then shows that the ammeters on the switchboard and connected in the machine circuits would indicate more current from the first machine than from the second although the two are really delivering equal currents. He also takes the case of two armatures having equal resistances, but the series winding and cable connections of the first have a greater resistance than that of the second; the switchboard ammeters will then indicate equal currents, while as a matter of fact the difference in the currents delivered by the two armatures may be considerable. He concludes that ammeters in machine circuits are not reliable guides for measuring the output of compound dynamos running in parallel, unless they are connected between the brush and its connection with the series winding. It therefore becomes very necessary that the proportions of the resistances referred to should be accurately adjusted; small differences of voltage at the ends of the special brush connection may give rise to large currents. In the station with which he is connected the speeds are adjusted until no current passes through the special brush connection; the relative resistances of the armatures is then a matter of indifference so far as apportioning the load is concerned, but the resistances of the series windings and cable connections should be adjusted so as to be inversely as the maximum rated current output of the machines. The absence of current in that special connection is indicated by polarized needles wound with a few turns of coarse wire connected as a shunt to the special connection; when deflected, the speed of one of the machines is adjusted until the needle points to zero.

Inert Dynamo Magnets.—In the Lond. "Elec.," Oct. 18, Mr. Pigg offers an explanation of the phenomena noticed in the Digest, last week. He thinks a more probable cause than the one suggested, is that the dynamo was switched on to the cells at a time when its voltage was less than that of the battery, under which circumstances a current from the battery would pass through the armature in the opposite direction and only a small portion would go through the shunt magnets, but, of course, in the proper direction; when the automatic cut-out acted, the self-induction of the armature and shunt circuits would act in opposite directions to each other in one closed circuit, and if the self-induction of the armature is the greater, the resulting current will demagnetize or even reverse the polarity of the field magnets. The same thing might happen when machines are connected in parallel.

Graphical Theory of Multiphase Motors.—The "Elec. Zeit.," Oct. 17, contains a short communication by Mr. Danielson in reply to the article by Mr. Heyland, mentioned in the Digest, Oct. 26.

Influence of E. M. F. Curve on Iron Losses in Transformers.—The Lond. "Elec.," Oct. 18, contains an article by Mr. Feldmann, which is practically a translation of the German article abstracted in the Digest, Aug. 31. He describes a graphical method of showing the differences between the iron losses for peaked and flat E. M. F. curves. In trying to introduce the real shape of the curve the first difficulty is that not only the E. M. F. curve but also that of the magnetism contains wrinkles due to the higher harmonics and the iron is therefore carried through hysteresis cycles with loops which are passed with several times the velocity of the main cycle, and must therefore change their position with reference to the main cycle. In addition to what was given in our previous abstract the following results may be of interest; the same transformer with the same voltage, 105 volts, and with differently shaped E. M. F. curves, gave the following iron losses: With a frequency of 40 for a peaked curve and a primary current, 301 watts, and for a transformed current, 257 watts; with a frequency of 42, a flat curve, and a primary current, 262 watts, while with a transformed current it was 296 watts.

Behavior of the Carbon Brush.—The article by Prof. Ryan, abstracted at some length in the Digest, last week, is reprinted in full in "El'ty," Oct. 30.

LIGHTS AND LIGHTING.

Miniature Lamps.—According to "L'Energie Elec." Oct. 16, the Zurich Lamp Company makes lamps of 110 volts and 3 cp requiring only 11 to 12 watts and others for 50 volts and 1.5 to 2 cp requiring 6 to 7 watts.

Lantern Arc Lamp.—The Ross-Hapworth hand-feed lamp is illustrated and described in the Lond. "Elec. Eng." and Lond. "Elec.," Oct. 18.

POWER AND HEAT.

Elevator Controller.—An illustrated description of the controller of Siemens & Halske is published in the "Elek. Zeit.," Oct 17, one of the chief features regarding it being that it is at the same time a safety apparatus; it is claimed to be quite different from those in general use. For switching in the starting resistances a succession of carbon contacts are used, the carbons for which can readily be renewed at a small cost; one of the advantages of this is that it is then possible to do with much fewer steps than when metallic contacts are used; in most installations in which a 7 hp motor is used, a resistance of 4 steps was found to be ample; when the circuit is closed the motor starts to revolve with the whole of the resistance in circuit with the armature, and as the motor speed increases, one after the other of the resistances are automatically cut out, the resistances being, therefore, cut out in proportion to the increase of the speed; this acts also as a safety apparatus, for if for some reason the motor cannot move, the resistance will not be cut out and the armature will be protected; it is, therefore, a much better safety apparatus than fusible plugs, which latter must be amply large, so as not to be continually blowing, and may, therefore, allow a dangerous current to pass. The reversing apparatus is separate and also contains carbon contacts.

Traveling Crane in Ship Building.—The Lond. "Elec.," Oct. 18, publishes a well-illustrated description of the overhead electric traveling cranes used by a ship-building company; the operation of building is carried on within a roofed structure, from the top of which the traveling cranes are supported; the crane moves from end to end on two tracks about 12 feet wide; the use of steam cranes at this height presented many objections and it was therefore decided to use electric power; a 25-hp motor is used, and the various movements are obtained by means of pulleys, the reversing being accomplished by means of double clutches and a miter gear; the weight of the whole crane is about 14 tons and its full load appears to be 3 tons; it is arranged so as to be impossible to strain the crane or lift more than the maximum weight. Sufficient experience has been gained to prove their satisfactory working.

Limits of Electric Power Transmission.—The "Eng. Mag." for November contains a short article by Mr. Adams. He thinks that the electrical industry has suffered repeatedly from a failure to recognize the fact that there is a wide difference between the physically possible and the commercially practicable; before long-distance transmission can become common it must be shown that it is possible to deliver power more cheaply than can be generated at the point of use; he takes the cost of steam power in cities as that which the total cost of transmitted power must not exceed; he calculates in detail, as an illustration, the case of 1,000 hp transmitted 25 miles at 10,000 volts, with the aid of transformers, and finds that under ordinary conditions for a ten-hour day's work, power would have to be delivered to the electrical generators absolutely free to warrant its transmission for 25 miles; with absolutely free fuel, steam power could not be generated for less than $25 per hp per year for 20-hour days, and he therefore concludes that transmitted steam power from points where fuel is cheap or even free, is out of the question in the case assumed; when the cost of water power can be procured at less than $13.33 per hp-year transmission becomes commercially practical for a 20-hour day; if the generators and motors could be constructed for high voltage, thus avoiding the use of transformers, the cost of transmission can be considerably reduced, and it is probable that many water-power transmissions from 5 to ten miles could be profitably carried

on with such an apparatus. He considers that his calculation is sufficient to show that electric transmission on a commercial basis is limited to much shorter distances than is generally supposed; if continuous-current generators and motors can be connected in series there would be many cases where the transmission of moderate amounts of power from 25 to 50 miles is commercially practicable; there are cases where the cost of steam power is excessive and this will warrant a much larger transmission cost; he points out the importance of duplicate machinery in order to make the service reliable, as also underground wiring and accessibility of circuits, all of which conditions are hard to attain in long-distance transmission; on the score of reliability alone he therefore thinks it doubtful whether any plan for the general use of energy transmitted from a great distance would be permanently successful, as a coal pile in the cellar would be far more assuring to the average householder than a slender wire exposed for 100 miles or more. He considers it evident that all plans for the transmission of power from great waterfalls or from cheap fuel at the mine, with a view to the competition with steam power produced in large cities, are based on a misapprehension of the facts and can only result in final disaster, if attempted.

Mining Plant.—A description of the plant at Scott Haven, Pa., of a capacity of 300 kw, including pumps, fans, haulage and coal cutters, is published in "Rose Technic" for October; it is said to be one of the most complete plants of the kind in existence.

Distribution of Power in Collieries.—The paper by Mr. Atkinson, which was abstracted in the Digest last week, is reprinted in full in the "Eng. Mag." for November.

TRACTION.

Electricity on Steam Railroads.—According to "Elec. Tech.," Oct. 15, there is a project under consideration for the construction of a line in Hungary from Budapest to Keszthely, a distance of 120 miles.

Electric Carriage.—A long abstract of the article which was noticed in the Digest last week is published in the Lond. "Elec. Eng.," Oct. 18, in which the illustrations are also reproduced.

Steam Road Carriage.—A well-illustrated description of the Serpollet carriage, with detailed illustrations of the very peculiar non-explosive boiler, is published in the Lond. "Engineering," Oct. 18.

Power Transmission and the Electric Railway.—In an article by Dr. Bell under this heading in the "St. Ry. Jour." for November, he discusses the use of higher voltages for longer distances. While 1,000 volts might be dangerous in crowded cities there are many long, cross-country interurban roads which, outside of city limits, could use with safety 1,000 volts; he calls attention to the difficulties encountered in the construction of generators for high voltages and at the same time strong currents; any very great increase over the present practice would not be justified until more experience has been accumulated in that line; it would be very simple, however, to connect two generators in series giving a thousand volts for long-distance purposes while the same generators would be available at the city ends of the line where the three-wire system might be used; the subject of motors does not involve any serious difficulty; the cost of copper for a line is unpleasantly large and even 1,000 volts is not sufficiently high to conquer the long lines which are now being contemplated, although by the use of several stations a line 30 or even 40 miles long would be possible. Regarding long lines for a high-speed service, he states they can be freely operated at any desirable voltage which may prove practicable; one of the most serious difficulties in such lines concerns the trolley, as it is no simple matter to conduct such large currents through trolley contacts; an increased voltage would reduce the current at this contact; a 1,000-volt system, he states, is a practical and convenient method of working long or heavily loaded lines. An interurban road, with power stations near each end of the city sections, can be conveniently operated at 500 volts at the city ends, and double this for the interurban portion; such a combination is well suited for a large number of cases. He considers that the sub-station plan, unless coupled with alternating-current transmission, is not at all to be recommended.

Gas Engine Station for Trunk Line Railway.—The "Elec. Eng.," Oct. 30, gives an abstract of some remarks made by Mr. Westinghouse to the directors of the Pennsylvania railroad. He gave arguments showing that the gas engine would use but ⅛ of the fuel of an ordinary locomotive, to produce the same amount of power; as that road consumes about 5,000,000 tons of coal per year east of Pittsburg, the saving of coal and cartage would be very great and would justify a large enough capital expenditure to cover the complete equipment of the railway; such gas stations could be located 10 or 12 miles apart so that there would always be two or three furnishing current for any particular part of the line.

Electricity on Steam Railways.—According to "Elec. Rev.," Oct. 30, Col. Prout, in a paper on "Electricity on Railways and its Problems," advised the railways to use the trolley system for suburban service. In the annual report of the N. Y., N. H. & H. railway, it is stated that the success of the experiments of the Old Colony Division has been so satisfactory that the new motive power "will be promptly adopted at other points on this line."

Electrically Driven Ocean Steamers.—According to the "Elec. Eng.," Oct. 30, Mr. Hickley believes that the reason why Atlantic steamers cannot increase their speed is that they cannot drive their propellers fast enough without shaking the boat to pieces; his plan, therefore, is to put in a powerful engine of the slow speed type, connected to a multipolar generator of say 500 volts and place electric motors directly on the propeller shafts which could then be run from 600 to 900 revolutions while the engine is making only 60 to 80; there would then be scarcely any vibration in the ship and the propellers dipping in and out of the water in rough weather could not affect the main engine nor jar the vessel as at present. He intends to fit up a 40-foot boat in this way to demonstrate what can be done.

Electric Car Tests.—In the installment of the serial of Mr. Hermann Hering in the "Elec. Ry. Gaz.," Oct. 26, he gives the performance of cars on street grades at various loads and controller positions, which are of interest as showing the results of steady conditions and the effect of running the motors in series or in parallel; cars were started several hundred feet in advance of the point where the test began, to be sure of absolute uniformity in speed, and the readings were found to be very constant; cars were run alone, with trailers and coupled to another motor car with a dynamometer giving the mechanical horse-power of the trailer; the figures are believed to be correct within a few per cent.; the net efficiencies of the motors was determined, and agreed fairly well with those published by the manufacturers. The curves show a maximum efficiency for 14 miles an hour when the motors are in parallel, and 7 miles an hour when the motors are in series; a table gives the results of a comparison of the the motors when running in parallel and in series, and a curve is given showing the difference between the electric hp and the difference between the two motors; the difference may be due to the resistance of the motors but more probably to differences in the size of the wheels, which are very apt to wear differently; the motors were loaded with 12.5 to 71.2 hp which is quite a range in power; a table gives the power per ton and per ton mile for the different tests.

Surface Contact System.—The electromagnetic or "E. M." system devised by Mr. McLaughlin, is described with the aid of a number of illustrations, in the "Elec. Eng.," Oct. 23. As in all such systems, the conductor is laid in sections flush with the pavement midway between the rails, and the sections are connected to the circuit by means of switches placed underground, which in this case are operated by electromagnets carried by the car. The junction boxes in which the connections are made are hermetically sealed; each box contains a jackknife switch which is operated by a horizontal rocking lever containing iron plates close to the top of the box; the electromagnets on the cars are placed so as to act on one or the other end of this rocking lever, thus either closing or opening the switch; provision is made for locking the switch when open so that it is impossible for the circuit to become closed except by the passage of the electromagnet over the top of the box; the distances between the magnets are 13 feet and they are carried 3 inches above the top of the box cover; they are wound with fine wire and connected in series across the circuit; not more than two sections are alive at one time making a maximum length of live conductor of 23 feet; there is an automatic cut-out in series with the two magnets, the object of which is to open the circuit if for any reason the current is interrupted, and it then throws into circuit a bank of 5 storage batteries connected to a coarse winding around the magnets which gives a means of controlling the switches in case of an emergency, as that due to the blowing of a fuse; 500 volts are to be used.

Electromagnetic Switches in Railway Conduits.—Mr. Bates in the "Elec. Eng.," Oct. 30, criticises the recent statement of Mr. Johnson in which the latter claimed that the electromagnet was "about the most reliable thing in the physical world" in connection with the description of his conduit system. Mr. Bates claims that the testimony of any telegraph operator is by far the reverse as his magnets need constant adjustment and he thinks that it will be far worse when placed in a closed conduit for operating railways; he quotes Mr. Stetson who, in referring to electromagnetic switch devices, states that they have proved a constant source of trouble and adds that "all of us who have had any experience with electromagnetic switch devices know that the less number we have of them the better they work." He claims that the conditions under which Mr. Johnson made the tests of his road are in no way comparable to those on dirty streets; he believes that the success of the closed conduit system depends on finding an effective and safe mechanical switching device "and unless this can be found there is no hope for it."

Conduit System.—The Diatto system which was described in the Digest, Oct. 26, is illustrated and described in the "Elec. Ry. Gaz.," Oct. 26.

Remedy for Electrolysis.—In the "Elec. Ry. Gaz.," Oct. 26, Mr. Brown replies at some length to the criticisms (see Digest, Oct. 12) of his recent article in that journal (see Digest, March 30); he states that he met these criticisms effectively both in theory and in practice, in other articles which he has written and quotes at some length from one in "Cassier's Mag.," which was abstracted in the Digest, Oct. 12. Regarding the article of Mr. Bain in a recent number of THE ELECTRICAL WORLD he claims that the writer is wrong in assuming that electrically continuous rails are merely an ideal construction and beyond the reach of practice; in Buffalo, Brown recently laid an underground feeder composed of four lengths of old rails 1,500 feet long and weighing 52 pounds to the yard; they are connected in parallel with the plastic rail bond; the drop in this feeder with 1,100 amperes is only 4 volts; copper cannot compete with properly bonded

rails; he thinks Mr. Bain's scheme would prevent electrolysis on a smal' road with dry soil, but even a large feeder cannot compete in conductivity with a network of pipes of a cross-section of 20 to 50 inches and laid in moist earth. The same journal contains an editorial reply.

Advance of the Railway Motor—An article in the "Elec. Ry. Gaz.," Oct. 26, shows how the railway motor developed into its present form, and gives the reasons why the present form is the preferable one. Ring armatures seemed preferable but the radical improvements in drum armatures have done much to make it superior to the ring in the eyes of many; although toothed armatures were first looked upon with suspicion, both ring and drum armatures became toothed, affecting great economy in weight and magnetic power, and it was an advantage particularly to the drum type of armature; in this, the coils are now machine formed and identical in shape with each other and it is this which gives the drum armature prestige over the ring; the present standard motor has a toothed multipolar drum armature wound with machine-formed coils; other improvements consist in the use of iron-clad and hinged fields. It is thought that the street railway motor has now reached such a state of perfection with regard to its windings that it would be difficult to imagine an accident to it which would involve more than a day's work for two men; the commutator is the only part which has not been improved lately; it is believed that there is urgent need of action in the matter of avoiding sparking due to reversals "for at present the case is of the worst possible description and is costing yearly many thousands of dollars;" it is suggested that it might be well to consider the advisability of two non-sparking positions, one for the forward and one for the reverse motion, to be operated when reversing the car; the commutator is and for some time to come will be, the weakest part of a railway equipment until the induction motor will propel railway cars.

Commutator Connections.—In an editorial in the "Elec. Ry. Gaz.," Oct. 26, attention is called to the objection to soldering the wires to the commutator, when the commutator must be removed for repairs, the solder also making the copper brittle; it suggests an apparently efficient method, which appears to be growing in favor, for remedying this evil. "The commutator is solidly built, and the wires driven into the slots, a flat piece of very soft solder being interposed between each pair of wires and in the bottom of each slot. The little column of wires interlaid with soft solder sheets is hammered into the slots, the solder spreading out under the pressure and shaping itself to the wires. The slots are of such depth that the last wire projects about one half of its diameter outside. On top of the wires is placed a thin hard strip of fibre which completely surrounds the commutator lugs and is secured in position by an ordinary binding wire similar to that used on the armature. To disconnect the commutator it is merely necessary to cut the last-named wire, when, after the other fasteners have been removed, the commutator may be drawn off the shaft." It is believed to meet the question, reduces the work of making the connections, and avoids making the ends of the wire brittle besides having the great advantage that it is cheap.

Load Diagrams.—The "St. Ry. Jour.," for November, publishes the load diagrams of the total load of all the stations in Boston, and the total number of cars, for several days in June of this year, and for Dec. 10 of last year, on which day the stations carried the heaviest load which was ever carried on their lines; the average for the June days corresponds to about 15.6 to 17.8 amperes per car, the load being almost entirely open cars.

Staten Island Railway.—A description of this line, which is under construction and which is said to be one of the largest and best equipped suburban lines in the country, is described and illustrated in the "Elec. Ry. Gaz.," Oct. 26.

Budapest.—A brief, illustrated description of the present system and the underground system, under construction, is given by Mr. Wessels in the "St. Ry. Jour." for November.

Havre.—A brief, illustrated description of the plant in that city is published in the "St. Ry. Jour." for November.

Car Heating.—The Montreal Convention paper by Mr. McElroy is published apparently in full with the aid of numerous illustrations in the "St. Ry. Jour." for November.

Ties and Poles.—The Montreal Convention paper of Mr. Brown, which was abstracted in THE ELECTRICAL WORLD Oct. 26, is published in full in the "Elec. Ry. Gaz.," Oct. 19.

Present Status of the Air-Brake.—The Montreal Convention paper by Mr. Wessels, which was abstracted in THE ELECTRICAL WORLD, Oct. 26, is published in full in the "Elec. Ry. Gaz.," Oct. 19.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Lightning Arresters.—An editorial in "Elek. Zeit.," Oct. 17, calls attention to the general unsatisfactory character of lightning arresters for lighting and power circuits, stating that even the best do not offer the degree of safety which is desired; the difficulty is believed to lie in the fact that it is not possible to create sufficiently powerful artificial lighting for systematically testing such an apparatus and it therefore suggests that data based on actual experience be gathered systematically by a commission both as regards the apparatus and the way it is applied; it is thought possible that valuable light may thereby be thrown on the subject.

Gas Engine Station.—The "Elec. Eng.," Oct. 30, reprints in abstract a description of the plant at Morecambe, which was abstracted in the Digest, Oct. 26, and in which a Dowson gas generator is used.

WIRES, WIRING AND CONDUITS.

Wire Machines.—An automatic coiling apparatus and a cable measuring wheel made by Johnston and Phillips, are described and illustrated in the Lond. "Elec.," Oct. 18.

ELECTRO-PHYSICS AND MAGNETISM.

Experiments with the Electric Arc.—An article by Mr. Lehman from the "Wied. Ann.," page 361, is abstracted at some length in the "Elek. Zeit.," Oct. 17; he examined the flame of the arc and discharges in rarified gases. With two horizontal electrodes the arc appears to consist of two inclined flames which in some experiments were 20 inches or more in height; in order to compare the flame with the light in the Geissler tube and in the electric egg, he used the largest glass bulbs that could be procured, which were 16 inches in diameter and 20 inches high; the electrodes consisted of thick cylindrical blocks of copper, brass or iron and sometimes of carbon. He first determined to what extent the surrounding gases take part in the arc; he therefore formed an arc of 3 amperes and 400 volts in this bulb; for pure air the electrodes were surrounded with red and blue light respectively and between them was a dark space like in Geissler tubes; if some iodine or oil vapors are introduced a green light surrounds the red and blue, filling the complete bulb; as the air pressure was increased, this green layer of light decreased in size and ultimately formed the outer layers of the flame of the arc. He concludes that the outer surface of this green layer is that which separates the gases through which current passes, from those which do not take part in the discharge, and describes several experiments made with smoke to substantiate this. The supposition that the two inclined flames from a horizontal arc are streams of gases going out from the points, he considers as wrong and states that vaporization of the carbons does not take place in the regular, quiet arc, but only in the hissing arc. On examining the flame of the arc he finds that it acts like a very flexible bundle of conductors. That the arc can be drawn out into a point by means of a magnet, he says is due to the fact that particles of dust which are carried in the air currents are heated to incandescence and give the impression of a sharp point to the flame; he states that in the discharge in the arc one must not assume that there is a stationary electric current but that every layer in the arc represents a separate partial discharge.

Development of Heat by Electric Oscillations.—A translation of a paper by Mr. Klemencic from the "Wied. Ann.," No. 4, 1895, describing an apparatus for the demonstration of the development of heat in wires by electric oscillations, is published in the Lond. "Elec.," Oct. 18. For electric oscillations the distribution of current over the section of the conductor is different from that for a steady current and as a result the resistance of wires are different for oscillations than for steady currents. He describes and illustrates an apparatus by means of which this has been confirmed quantitatively; it consists chiefly of two air thermometers, the wires to be experimented on are contained in their bulbs, and are about 0.4 mm thick, the two wires being of nearly equal length and thickness but of different materials; the duration of the oscillations was very likely less than 10 to the minus sixth power, second. In making the experiments, a direct current from the battery was first passed through the two wires and the temperature noted, the ratios between which should be the same as that between their resistances; after this the wires were heated by electric oscillations obtained by discharging a condenser through a spark gap, and through the two wires in series, it being charged by an induction coil. For German silver and brass wires the ratio of the readings for a steady current was 3.7, which is nearly equal to that of the resistances, while for the oscillations it was 2.2, which corresponds with theory; for iron and platinum-iridium wires the ratio was 1.8 for the direct current but for the oscillating currents the rise was greater for iron than for platinum-iridium as the resistance of the oscillations increases very much with the magnetizability of the wire.

Electrical Vibrations in Tesla's Experiments.—A brief abstract of the article by Mr. Oberbeck, which was mentioned in the Digest, Oct. 26, is given in the Lond. "Proc. Phys. Soc.," for October.

Electric Resonance.—A paper by Mr. Bjerknes, from the "Wied. Ann.," Vol. 55, page 121, is abstracted at some length in the Lond. "Proc. Phys. Soc." for October.

Loss of Energy in Dielectrics.—"L'Ind. Elec.," Oct. 10, contains an article by Mr. Gassnier, in which he gives a good summary of the results obtained by a number of scientists to prove or disprove the existence of a dielectric hysteresis. It has been found that besides the loss in a condenser, due to conduction, there is another and larger loss which is of a different nature; Steinmetz measured the loss for a paraffined paper condenser of 3 microfarads with a current of 170 periods, finding that the loss is 12 times that produced by a continuous current, and that this loss increased with the square of the voltage. Arno made an experiment which he believed showed a dielectric hysteresis of two kinds, one depending on time and the other being analogous to magnetic hysteresis;

Northrup found a difference of 3 per cent. for paraffine between a small varying field and a rapidly varying field and for glass 6.2 per cent.; Janet attributed his results to a true hysteresis and a viscous hysteresis. On the other hand Hess believes to have proved that the losses noticed can all be shown to be due to conduction: Borel came to the same conclusion, while Porter and Morris believe to have shown that the losses are due to viscous effects and not to hysteresis; Benischke found no increase in temperature in a paraffined block and concludes that there is no hysteresis, believing that the losses are due to the formation of residual viscous effects, to Joule effects and to mechanical vibrations of the parts of the condenser; Eisler believes the losses are attributable to viscosity and that for a certain frequency this would be a maximum. It follows from all these experiments that the existence of a dielectric hysteresis, analogous to magnetic hysteresis, cannot yet be considered as having been demonstrated, and that it may therefore not exist; there remained two hypotheses, one of a viscous hysteresis and the other of interior conduction.

Theory of Larmor.—The article by Mr. Poincaré is continued at some length in "L' Eclairage Elec.," Oct. 5; he discusses the theories of Hertz and others and draws conclusions.

Axial Character of Lines of Magnetic Force.—A paper by Mr. Kolacek from the "Wied. Ann.," Vol. 55, page 503, is abstracted in the Lond. "Proc. Phys. Soc." for October. He shows that the direction of the magnetic force is that of an axis of cyclic motion; calling a vector a "direction," when some phenomenon takes place along it, and an "axis" when some phenomenon takes place around it, he shows from the Hall phenomenon that the magnetic force must be essentially an axis. He states that the Hall effect does not furnish an answer to the question whether magnetic lines are the axes of a static cyclic polarization, or the cyclic phenomenon in some way depending upon it.

The Law of Hysteresis.—Mr. Friese in the "Eleke. Zeit.," Oct. 17, gives the results of a number of experiments made by a German firm, in the form of the chemical composition of several kinds of iron, together with the Steinmetz coefficient for each one; no conclusions are drawn.

Magnetic Force Due to any Plane Circuit.—Mr. Everett, in the Lond. "Elec.," Oct. 18, proves that Colard's formula (see Digest, Oct. 12) is not correct; he proves it by applying it to the case of a circle.

ELECTRO-CHEMISTRY AND BATTERIES.

Formation of Persulphuric Acid in Accumulators.—In the "Zeit. f. Electrochem.," Oct. 5, Dr. Schoop answers a recent criticism of Mr. Elbs (see Digest, Aug. 24 and Oct. 19). He thinks that the experiments of Elbs, the value of which he appreciates, have only an indirect connection with the theory of Darrieus; in order to prove the incorrectness of that theory it would be necessary to show by repeated experiments that the results obtained by Darrieus were not correct, but no such proof was contained in the experiments of Elbs and Schoenherr; their experiments were made with platinum electrodes under certain conditions, while those of Darrieus were made with lead accumulators under normal conditions; he does not consider that the theory of Darrieus cannot be disproved, but he thinks it the best one yet offered, and that the corrosion of the grids can be explained by the production of persulphuric acid. That there are only traces of persulphuric acid in lead accumulators is not sufficient to overthrow the theory of Darrieus as that is no proof that it was not formed as a primary product; little is known of the products formed during electrolysis and especially in lead accumulators; there is not even a method known to measure the difference of potential of the electrodes in an accumulator as compared with an auxiliary electrode, while the current is passing.

Capacity of a Storage Battery After Five Years' Use.—A short article by Messrs. Strecker and Karrass in the form of a contribution from the government telegraph department, is published in the "Elek. Zeit.," Oct. 17. They give the results of tests made with a plant of 120 Tudor cells of 52 ampere-hours, which was installed in the main telegraph office in Berlin in 1890 and has now been in continual use during five years; the results showed that the capacity had increased quite appreciably; during the whole time there was never an interruption and never any necessity for repairing a cell. The conditions for using it were as follows: acid, 19°B; it must be charged with 8 amperes until the voltage is 2.65 per cell; every two months it was to be charged so long that the hydrometer shows no change during 4 hours; the discharge can be at the rate of 10 amperes down to 1.85 volts, but the usual current was not more than 0.25 amperes; the batteries were charged about every 10 days. From the curves, the capacity of one of the three groups seems to have increased from 53 to 82 ampere-hours, and of another from 53 to 74 while that of the third increased from 53 to 54.

Cyanate of Calcium, a New Nitrogen Fertilizer.—A short Academy note by Mr. Faure is published in full in "L'Ind. Elec.," Oct. 10, and is editorially referred to as a matter of considerable interest. Cyanate of calcium has heretofore existed only in small quantities in laboratories; it is richer in nitrogen which can be assimilated, than the well-known nitrate of soda; it can be made in a single operation in a high electric furnace into which a mixture of limestone and carbon is introduced successively, and first heated directly to 1500°C then subjected to a second heating by means of electricity to 2500°C in the presence of a large excess of pure nitrogen, and, finally, to an oxidation by means of air from which the oxygen is retained by the product while the nitrogen carries away the heat due to the oxidation; it is important to use a high furnace in order that the calorific efficiency is sufficiently good. He believes there is no doubt concerning the assimilation of the nitrogen of this product by plants.

Purification of Oils.—A process devised by Messrs. Aspinwall, Hoar and Wise is described briefly in "L'Elec.," Oct. 19. The vessel is divided by a diaphragm into two compartments; the positive contains a solution of ordinary salt and an electrode of carbon while the negative the oil mixed with an equal quantity of salt solution, kept in continual agitation, and an electrode of copper; 6 volts are required; it is well to avoid a generation of heat higher than 82° C.; chlorine is disengaged by the process; sulphuric acid can be used instead of the salt; a high voltage discharge at the bottom of the liquid can also be used as also the light and heat from incandescent lamps placed in the oil; no further details are given.

Purification of Sugar Liquors.—The Say process of preventing incrustations is briefly described in "L'Eclairage Elec.," Oct. 12. In the electrolysis of certain sugars a deposit composed chiefly of oxide of lead is formed on the metallic electrodes, and it follows that certain organic acids whose affinity for these deposits is not strong remain in the liquor, and that the deposits, which are very adhesive, interfere with the passage of the currents; to avoid the formation of these deposits he adds $\frac{1}{8}$ to $\frac{1}{10}$ in weight of the ashes of saccharine matter or common salt, or an acid which forms an insoluble salt with lead; the electrodes should furthermore have a large surface and should be kept in motion.

Diaphragm.—According to "L'Eclairage Elec.," Oct. 12, the Comboul diaphragm consists of two porous membranes, as of paraffined paper for instance, stretched over a frame parallel to each other, the space between them being filled with salt water or a solution of a salt which does not interfere with the electrolysis; the liquid is kept in circulation, and it is thought that thereby the life of the diaphragm will be greatly increased.

Effect of the Glow Discharge on Oxide of Lead.—A paper by Mr. Warburg is translated from the "Wied. Ann." No. 4, in the Lond. "Elec.," Oct. 18. He gives the results of a number of experiments from which he concludes that there is reason for thinking that the rays affect the oxide of lead but not the surrounding gas, causing a change in the former which makes it susceptible to the combination of oxygen and hydrogen.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Comparison of Automatic Air Pumps.—A brief abstract of an article by Mr. Neesen in the "Zeit. f. Intrumk.," No. 15, is published in the Lond. "Proc. Phys. Soc." for October; he distinguishes between two classes of mercury pumps, reservoir pumps of which the Geissler may be taken as a type, and the drop pumps of which Sprengel's is a typical example; for a fair comparison the cost is about the same in both; the method by which the degree of rarification was measured is explained and prices and figures are given of the results obtained; at the start the reservoir pump works more quickly than the other but the reverse is the case when the pressure falls below 0.1 mm; an advantage in favor of the former is that it is not breakable but a disadvantage is that it requires more mercury.

Hookham Meter.—An article on this meter is begun in the Lond. "Elec. Rev.," Oct. 18. After a history of the meter, a description is given of the one for continuous currents, as now made, which is practically a different instrument from its predecessors; the principal novel features are the compensating devices, including a double bearing and float in mercury for bearing friction, slotted and solid pole-pieces for changes in flux, and a magnetic shunt for changes in fluid friction. The resistance of the instrument is small and no shunt coil of any kind is used, the consumption of energy is therefore low.

Tracing Alternate Current Waves.—Prof. Blondel in the Lond. "Elec.," Oct. 18, states that the method recently described by Messrs. Barr, Burnie and Rogers (see THE ELECTRICAL WORLD," Oct. 12, p. 400) was described by him in the "La Lum. Elec.," Sept. 12, 1891, and Sept. 16, 1893; the only new element is the use of a mirror actuated by the cam, but he thinks the rotating drum preferable. The original authors in replying state that the advantage of the cam is chiefly in an instrument which visually traces a wave; for photographic purposes a screen or cylinder may be used.

Measurement of High Temperatures.—A paper by Mr. McCrae, from the "Ann. Phys. Chem.," is abstracted briefly in the Lond. "Elec. Eng.," Oct. 18. The thermoelectric cell used consists of platinum and platinum rhodium which gives readings approximately or proportional to the temperature between 300 and 1,400° (presumably centigrade). The fusing points of a number of chemicals are given in the abstract. The temperature of the alcohol flame was found to be 1,488°, that of the blue part of the Bunsen burner flame was 1,542° and that of the hottest part of the Bunsen flame was 1,725°.

La Chatelier Pyrometer.—An illustrated description of a form as made in Vienna, is published in the "Zeit. f. Electrochem.," Oct. 5.

Measurement of Cyclically Varying Temperature.—Mr. Burstall's paper abstracted in the Digest, June 22 (see also Sept. 21), is published in full with several plates of illustrations, in the Lond. "Proc. Phys. Soc.," for October.

Vibration Galvanometer.—The one briefly described in the Digest

last week is illustrated and described more fully in "L'Eclairage Elec.," Oct. 12.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long-Distance Telephony.—In an article of some length by Mr. Baradat in "L'Eclairage Elec.," Oct. 5, he describes a system which he calls a multiple induction system. He considers that a rational solution of the problem of long-distance telephony, is to treat it like a problem in the transmission of power, being careful to consider the question of efficiency and that the receiver produces variations in the current equal to those produced by the transmitter; he is therefore led to use currents of high tension, much higher than those in use at present; experiments made in Switzerland with a series of induction coils for determining what values are to be given to the different elements so that the transmission should be as clear as possible, show that his arguments are correct and that the higher the voltage the greater the distance, but what is gained in distance is lost by the reduced current in the receiver and he therefore used a double induction system like in the transmission of power, the microphone current being transformed up to a higher voltage in the line and the high voltage current received at the other end is transformed down again in another transformer before reaching the telephone receiver; a battery can also be placed in the high voltage line circuit in order to keep the line constantly charged thus overcoming the initial electrostatic and electromagnetic inertia; to avoid the effects of inertia the induction coils contain permanent magnets giving an initial magnetism; the transformers consist of two cores surrounded by the coils, the ends of the cores being connected by means of permanent magnets, the current tending to produce the same poles as those produced by the permanent magnets. He shows how the induction coils are calculated and gives a number of diagrams of the complete connections for various kinds of stations and also for the introduction of condensers. The adoption of this double induction system, he says, enables one to obtain great clearness and loudness besides considerable economy in the cost of the line, on account of the high tension currents; smaller lines also diminish the electrostatic capacity, which is one of the principal obstacles to telephonic transmission.

Water-tight Bell.—A form of water-tight electric bell made in London is described and illustrated in Lond. "El'ty," Oct. 11. The poles of the magnets are brought out through the water-tight case and operate on the clapper; there is a second clapper and armature in the inside of the case which operates the circuit-breaker; the two clappers vibrate in unison; it is claimed that they do not require more battery power than the ordinary forms.

Telegraphy in Canada.—A Canadian Electrical Association paper, by Mr. Dwight, is abstracted in the "Elec. Eng.," Oct. 30; it is chiefly historical. The total amount of capital invested in Canadian telegraphs is between six and seven million dollars and the total wire mileage about seventy-five thousand; in regard to the population there is no country in the world which enjoys a more extensive system of telegraphs than Canada, there is scarcely a town or hamlet in the whole country which is not connected. He gives the following table, which shows the number of inhabitants per telegraph office in different countries: Canada, 2,320; Switzerland, 2,556; Germany, 4,510; United States, 5,625; Great Britain, 6,417; France, 7,719; Holland, 10,254. No country enjoys a cheaper schedule of rates than Canada, taking into account the distances; a message can be sent over 1,200 miles for 25 cents.

MISCELLANEOUS.

Method for Making Metallic Mirrors.—A process devised by Mr. Boas is described in the "Zeit. f. Elec.," Oct. 15. It is based on the well-known fact that certain metals, especially those of high specific gravity, that is, the noble metals, when used as the cathodes in Geissler tubes, are volatilized by the passage of a discharge and deposited as metals or oxides on the surface of the glass; if the tubes contain a gas free from oxygen at low pressure and especially if they contain hydrogen, the metals will be deposited on the glass in a pure, metallic and very dense state, producing a mirror of higher deflecting power than can be obtained by any other method. The rapidity of the deposition increases as the distance becomes less until this distance reaches a few millimetres, when it ceases; as the tendency to deposit is exercised in all directions, it is better, when the mirror is flat, to cover the cathode with an insulating material except where it faces the plate; no further details are given.

New Book.

A TREATISE ON THE LAW RELATING TO ELECTRICITY. By Simon G. Croswell. Boston: Little, Brown & Company. Sheep, 765 pages. Price, $6.00.

The rapid application of electricity to various commercial uses has produced a corresponding growth of statutes and adjudged cases, until there has been formed a considerable branch of the law devoted wholly to these subjects.

The aim of this book is to set forth this body of law in its present development. Prominent among the subjects which are included in this treatise are the nature and qualities of the various franchises necessary for electrical lines and the mode of acquiring them, including the important federal franchises of telegraph companies; the liability of electrical companies for negligence in the construction and maintenance of their lines and machinery; the municipal ownership of electric light plants; the placing of wires underground; the conflicting rights of electric railways and telephones in the same highways; the decisions as to the operation of electric lines, including especially telegraph lines, and covering the prevention of discrimination, the liability for errors or delay in the transmission of telegrams; the various stipulations on the printed telegraph blanks and their effect on the duties and liability of the telegraph company; the measure of damages in suits against telegraph companies, and important chapters on the taxation of electric companies and on electric railway accidents.

The work will form a valuable adjunct to the libraries of lawyers engaged in a general practice, and particularly to corporation attorneys advising electrical concerns. The book also contains much information for the layman, and should be in the offices of telegraph, telephone, electric railway and lighting companies. A remarkably large number of cases are cited, and a table is contained of constitutions and statutes relating to the subject treated.

Storage Batteries for Railways.

BY MAURICE BARNETT.

In these days, when it is the practice of not a few eminent electrical engineers to condemn the use of the storage battery for traction work, either by vehement denunciation or by "too faint praise," the announcement in the Kolnische *Zeitung*, that the trolley system which has been in use in Hanover for some time has been discarded, and that the twenty-eight cars operated on that system are to be remodeled and equipped with storage batteries, will prove very gratifying to those who, even in view of some discouraging failures in accumulator traction, have always had a firm conviction that traction work was a legitimate field for accumulators, and that the test of time would prove the ability of storage batteries to hold their own with other representative electric traction systems. Since the announcement in the Kolnische *Zeitung* news has been received here that the Dresden Tramway Company and the Hague Tramway Maatschappy have likewise decided in favor of accumulator traction. Inasmuch as the Tudor Storage Battery Company is making the installation it is not at all too optimistic to believe in the ultimate success of the storage battery cars about to be operated in the above-named places.

Up to the present time the engineers of the overhead system have had matters pretty much their own way. Occasionally a statement of results (coming in all probability from interested sources) bearing upon the success obtained with the open conduit has caused a commotion in the trolley ranks; but, save for that, the erection of poles has gone merrily on, and the manufacturers of trolley equipments have had no complaints to offer on the ground of lack of orders. The past two months, however, have been the beginning of a mighty change. To-day the trolley is considered to have been merely coincident with the evolution of the modern passenger railway, and that its usefulness in the future, at least in cities, is not likely to be greatly overestimated. Mr. E. H. Johnson, who was a pioneer with Lieut F. J. Sprague in working out the trolley system, writing in the *Electrical Engineer* under date of Oct. 9 sounds the doom of the overhead line, at least in cities and towns. The reason for this belief is to be found in the objection to overhead construction and in the fact that greater economies are possible in the newly projected closed conduit system, by reason of the fact that higher voltage may be maintained than is practicable in trolley systems. This criticism, emanating from one of the parents of the overhead wire system, may be considered to have some weight. Mr. Johnson also proceeds to pay his respects to the open conduit system anent the great ado made by the Metropolitan Traction Company, of New York, over the "practical success of their $150,000-per-mile open conduit system," by saying, "it was neither scientific nor businesslike to place the electrical conductors in a sewer and then expend hundreds of thousands of dollars to secure drainage." This represents the view that is at present held respecting the open-conduit electric system. Surely the friends of the accumulator can take hope!

Looking impartially at this question it would seem that the contest for supremacy in the field of transportation would in the future be between the storage battery and the closed conduit system. Which side will win cannot be conjectured at the present time. Neither system is in the form it will assume when the contest for supremacy takes place, and one is therefore precluded from indulging in prognostications regarding the outcome.

The above remarks have been called forth by statements appearing from time to time in some of the newer electrical journals reflecting upon the judgment of those who are instituting the test with storage battery cars on the Madison Avenue line in New York City. The remarks have all been characterized by a sneering incredulity as to the value of accumulators for traction work. Before the next six months are passed the critics of the storage battery system may have to reverse their conclusions.

The object of the present article is to emphasize the great value possessed by storage batteries, not in furnishing direct motive power, but when used in connection with railway power plants.

The first accumulators used in connection with a railway power station were, so far as the writer can ascertain, those employed in the power plant of the railway between Zurich and Hirslanden, Switzerland, an account of which was published in the *Electrotechnische Zeitschrift*

of June 28, 1894. According to report the dynamo delivers current under a constant load, the accumulators being charged or discharged as load on the line is less or greater than the output of the dynamo. In this plant there were automatic means for cutting in and out of end cells to keep the voltage constant. Results showed that by means of the accumulators a saving was effected of 2.2 pounds of coal per hp-hour, amounting to nearly a ton per day, or $2,500 a year. The cost of accumulators, installed complete with necessary apparatus, was $7,400. Allowing for interest and depreciation the battery paid for itself in four years by saving in coal bills alone. The saving was effected by reason of there being no necessity to keep a second boiler and steam engine in reserve, by which arrangement the power plant ran at its highest efficiency. It was furthermore developed that the first cost of combined steam power and battery plant was less than the cost of total steam power plant would have been for the same work. How important this installation proved may be judged from the fact that a single type of storage battery is now found in 80 per cent. of all central stations in Germany and Austria, besides being installed in fifteen railway power plants and 5,000 isolated lighting plants.

Two railways in the United Kingdom have recently attracted a great deal of attention; and as the batteries used are of the "Chloride" type, the installations have a special interest for American railway managers. These two railways are the Douglas-Laxey and the Snaefell Mountain Tramway, both in the Isle of Man.

The Douglas-Laxey line was established about a year ago. From the September 19, 1895, issue of *Lighning*, London, it is gathered that when the battery was connected to the line the cars immediately began to run with exceptional smoothness—the accumulators keeping the voltage steady and eliminating all sudden variations due to starting of other cars. How variations would otherwise arise will be understood when it is considered that it requires 150 amperes at 500 volts to carry a loaded car up the 8½ per cent. grade at a nine-mile rate.

Encouraged by the success attained by the Douglas-Laxey electric road, which after a year of service "had fulfilled in every way the expectation of its promotors," it was not difficult to secure capital to construct an extension of this road up to the summit of Mount Snaefell. The electric equipment of the Snaefell road resembles that of the Douglas-Laxey line, both being designed by no less eminent an engineer than Dr. Edward Hopkinson. By evening up the load on the generators the battery enabled the plant to work at a high efficiency and rendered the service extremely satisfactory.

A large economy is made possible by a special use of accumulators at seasons of the year when there is comparatively little traffic. Under the agreement with the authorities, the above-mentioned lines bound themselves to run two cars a day each way every day of the year. Obviously, it would not have paid to keep the power-house in operation just for this load, and this is where the battery proves so valuable during the Winter months. The battery being charged once a week can carry the load for the other six days without necessitating the running of the power plant.

In the United States there are two installations of storage batteries in connection with railway power plants which are of special interest. The first is at Merrill, Wis., where a battery of "Chloride" accumulators was installed to effect a solution of the problem so constantly occurring in the railway world, *i. e.*, how to bring up the capacity of the power plant to meet the requirements of a constantly increasing demand. It was decided to use a battery not alone for increasing the light capacity, but for regulating the voltage on the railway circuit which—according to the engineer who installed the plant—"was far from satisfactory owing to the great fluctuations in railway demand." As the lighting machine and railway generator were connected to the same shaft, it can be understood that the light furnished was far from satisfactory. Records kept before the battery was installed showed a fluctuation as high as nine volts on each side of three-wire lighting system. Mr. Herbert Condict, in a paper descriptive of this plant, read before the Northwest Association of Electrical Engineers at their last convention, spoke of the performance of this battery as follows: "The great improvement in running of cars was immediately noticed by all, but it was at night that the contrast was most apparent. The two waterwheels were connected together as usual, but the railway generator charged the battery at almost a steady rate instead of with its ever-varying demand of from 0 to 120 amperes per car . . . . Instead of a succession of sharp peaks the voltage curve of the lighting circuit became practically a straight line; instead of nine volts' variation, there was practically no variation, demonstrating most clearly the capability of battery to respond to all demands of railway, no matter how severe."

The second plant mentioned is now being installed at Anaconda, Mont., for the Electric Railway, Light & Power Company, of that place. The battery consists of 270 special cells of the central station type of 600 ampere-hours capacity, but capable of standing very heavy discharges. The object of the battery is to even up the load on the generators and maintain a constant E. M. F.

To sum up, it may be said that the storage battery is destined to play a very important part in the future in light, heat and power stations. The reason for this statement is to be found in the ability of a good storage battery to act,

First: As a reservoir in which may be stored up the energy representing the difference between the average and the maximum demand on a generating plant.

Second: As a regulator of pressure on circuits subject to fluctuating demands—increasing the efficiency of the service and diminishing the wear and tear on the apparatus, and

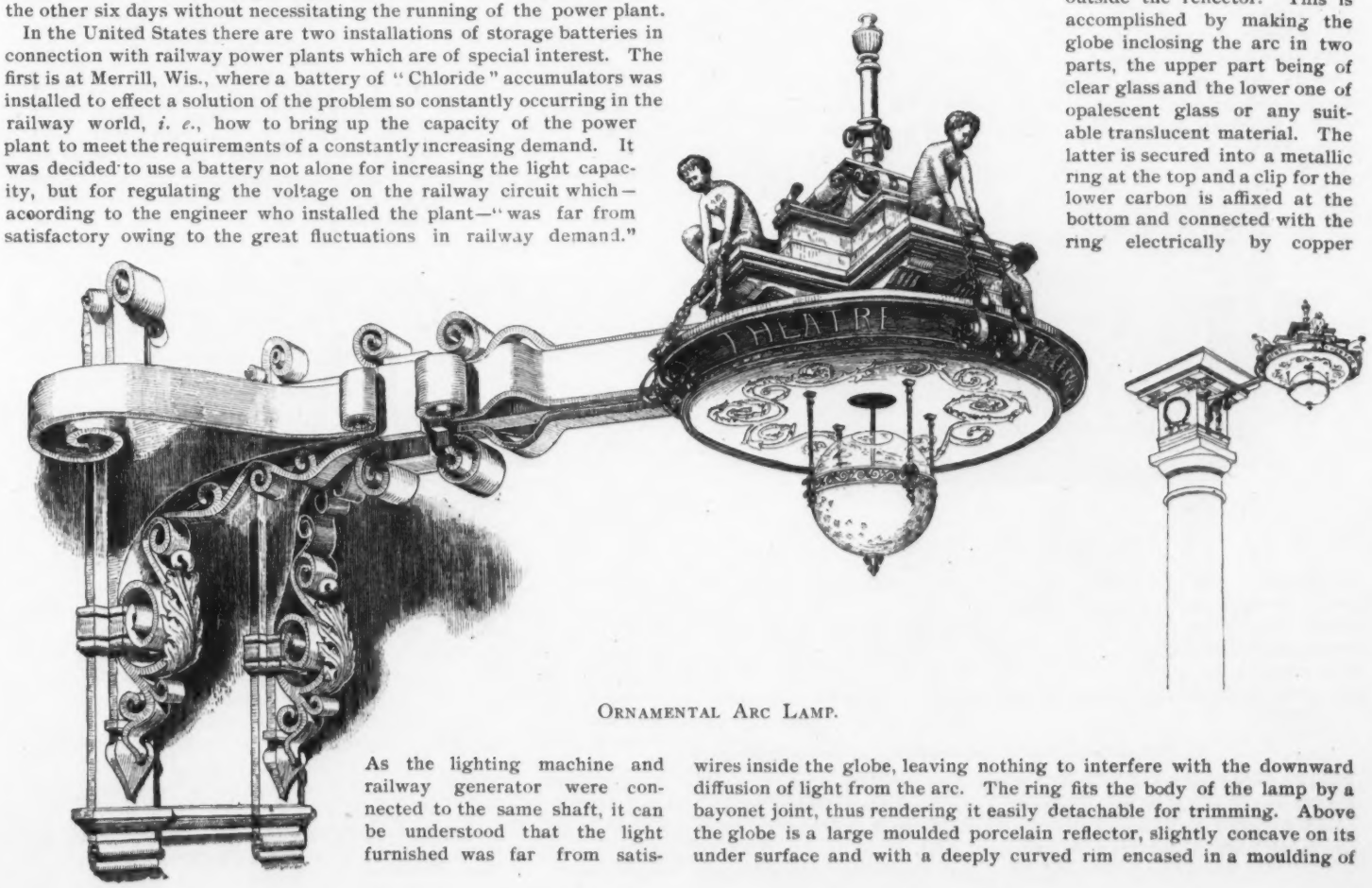
Third: As a transformer, to utilize high voltage charging currents and to discharge, when disconnected from generator, at any lower voltage desired.

One fact that has been demonstrated, and which has the most important bearing on the construction of electric railway power plants, or for that matter, of most electric light or power stations, is that in any station which has to meet a fluctuating demand for power a plant consisting of part steam power and part storage battery is cheaper in first cost than a total steam power plant would be for the same work. The high efficiency and satisfactory performance of such a plant has already been referred to.

Ornamental Design For Arc Lamp.

BY HERBERT P. KELLY.

The accompanying illustration is that of an arc lamp designed to give a strong diffused light downward, no direct rays being permitted to strike outside the reflector. This is accomplished by making the globe inclosing the arc in two parts, the upper part being of clear glass and the lower one of opalescent glass or any suitable translucent material. The latter is secured into a metallic ring at the top and a clip for the lower carbon is affixed at the bottom and connected with the ring electrically by copper wires inside the globe, leaving nothing to interfere with the downward diffusion of light from the arc. The ring fits the body of the lamp by a bayonet joint, thus rendering it easily detachable for trimming. Above the globe is a large moulded porcelain reflector, slightly concave on its under surface and with a deeply curved rim encased in a moulding of



ORNAMENTAL ARC LAMP.

sheet iron or bronze, in which are perforated letters. This reflector is apparently supported by chains held by the four cherubs posed upon the cross-shaped pedestal above, within which is concealed the feeding mechanism, arranged so as to be easily removable for repairs. This upper ornamental work is softly illuminated by light diffused through the porcelain reflector. The materials of which the ornamental parts are made are wrought iron, bronze, brass, porcelain and glass; the style is of the Renaissance suggesting the Greek. The lamp is designed for a theatre or concert hall, and is suitable for either interior or exterior illumination.

An Improved Fuse Box for Electric Cars.

The accompanying cuts show the Cardim proved fuse box for street railways, which is being manufactured by the Card Electric Company, Mans-

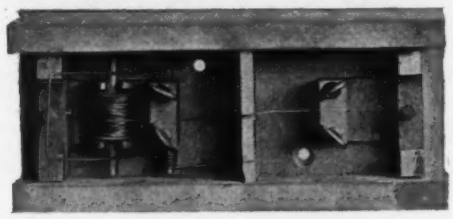


Fig. 1.

field, Ohio. Fig. 1 shows the slate box without metal case, which is well adapted for use on cars when placed under the seat or in some other protected place. It is made up with a slate bottom and sides, and has brass binding blocks at each end, to which are attached the connecting wires. At one end is a small spool, on which is wound a length of the fuse wire selected. The wire passes from the spool under a clamping piece on the

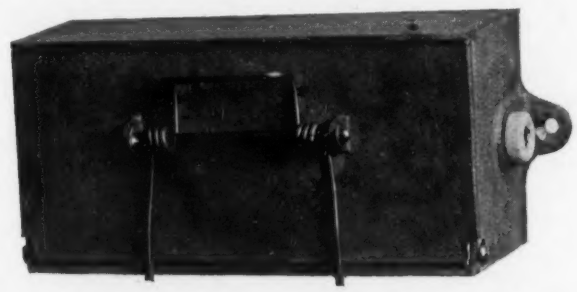


Fig. 2.

binding block, through a slot in the slate partition and under another clamp on the opposite binding block, completing the circuit. Fig. 2 shows the slate box in a metal case, for use on the outside of cars. The lid closes tightly and the box has a projection along the top, making it water and snow proof. A folded piece of asbestos slips inside the box along the sides, over the fuse, insulating the lid. Fig. 3 shows the box

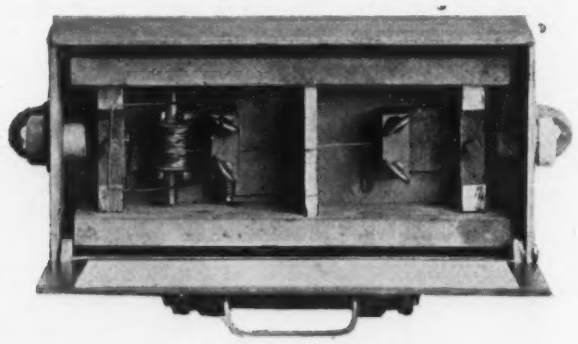


Fig. 3.

with the front open, exposing the fuse. The spring on the outside of the lid acts to hold it either closed or open.

When a fuse blows it is only necessary to loosen the thumb screws, pull through more wire and clamp it down. Each spool will hold 35 feet of No. 21 copper wire, enough for 100 50-ampere fuses. When the wire is used up the empty spool is taken out and a full one substituted without loss of time.

A Substitute for Guttapercha.

The following compound is said to serve as an excellent substitute for guttapercha: Tar, one part; paraffin, 10 parts; dissolve together at 120 degrees, and then add caoutchouc, two parts. Keep the mixture at this temperature until it becomes a homogeneous mass.

The Bacon Air-Lift Pump.

The comparatively recent introduction of the "air-lift" process of pumping is attracting much attention from mining waterworks and general hydraulic engineers throughout the country on account of its peculiar characteristics and the economical results obtainable by its use.

Broadly speaking, it consists simply in introducing a current of air into the discharge pipe below the natural level of the water, the specific gravity of the mixed air and water in the pipe being thus reduced to a point sufficient to raise the column to a height dependent upon the amount of the air current and the frictional resistance of the piping employed. A popular explanation of the action is that each particle or "bubble" of air introduced acts as a piston for a corresponding particle of water, and pushes it upward continually until able to "slide out from under" and free itself from the load.

The principle of operation is so extremely simple that where a water supply is accessible at a reasonable distance below the surface about all that is needed is an air compressor and a few lengths of piping; but, as in every engineering problem, a carefully evolved system, with its details thoroughly and intelligently developed, is necessary to secure the best results. The accompanying illustrations show the Bacon "Air-Lift," which is being placed upon the market by the Knowles Steam Pump Works, 93 Liberty Street, New York, and which possesses several interesting features, one of which is the peculiar disposition of the air supply pipe, which encloses and is concentric with the discharge pipe, a patented feature which results in the greatest possible economy of working space in a well tube of given diameter, as will readily be seen from a comparison of the sectional area of this arrangement with that of one having the air supply and discharge

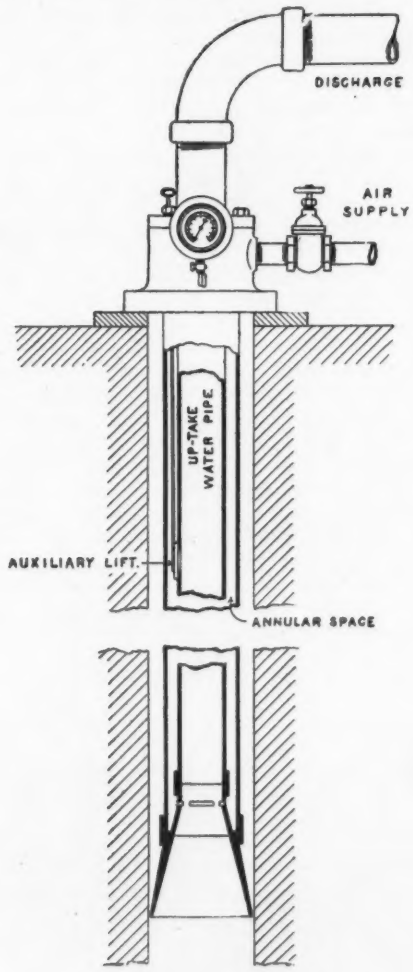


Fig. 1. Pump Head.

pipes placed side by side. An additional advantage possessed by this method is the introduction of the air evenly upon all sides of the water column, giving a higher efficiency than when the air is admitted at one side only. The funnel-shaped mouth of the discharge pipe not only serves to concentrate and steady the flow of water, but also prevents the loss of air outside of the supply pipe in case of over-pressure.

Another valuable and distinctive feature is the "auxiliary lift"—a valve introduced in the shell of the discharge pipe and designed to facilitate starting the flow under an unusually high speed.

No air-chamber is employed, as in ordinary pumping machinery, since the column of air in the annular space surrounding the discharge pipe effectually takes its place, not only holding the air in volume but maintaining it at the required pressure in actual contact with the moving

water, thus effecting a mixture in such proportions, it is claimed, as to secure the highest possible efficiency.

A special application of the Bacon air-lift pump is in increasing or restoring the flow of artesian wells which have become clogged with the sand and mud that naturally follows the vein of water. In wells drilled through sand strata, and having a strainer at the bottom of the well casing, the top of the up-take pipe may be closed from time to time as may be found necessary, and a sudden back pressure exerted, so as to reverse

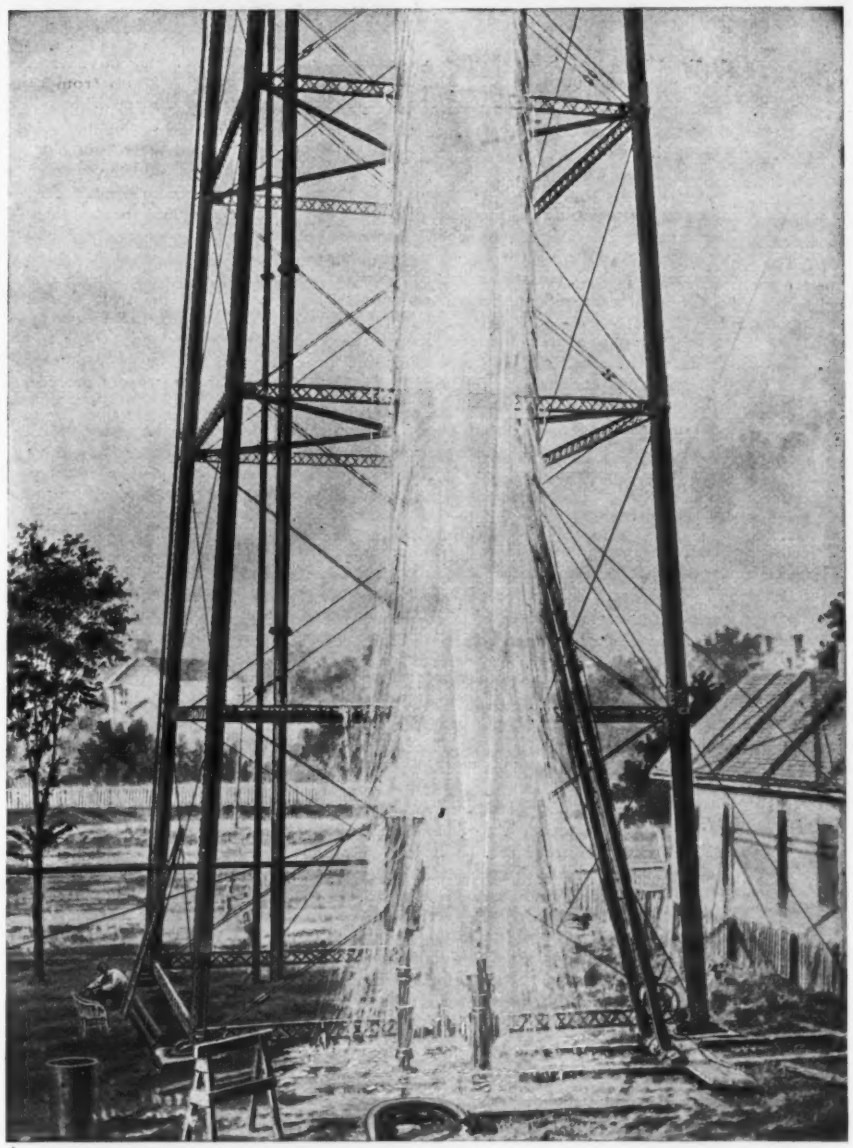


FIG. 2.—AIR LIFT APPLIED TO AN ARTESIAN WELL.

the direction of water flow and remove all obstructions lodged against the strainer, thoroughly cleaning it and restoring the normal output. The aerating effect secured in this method of pumping is exceedingly valuable in many cases, as the water is thereby made clear and sparkling and rendered much more acceptable for drinking purposes.

Visible Radiation and Temperature.

A new determination of the lowest temperature at which hot body becomes visible is published by Mgr. Pettinelli, in the *Nuovo Cimento*. He heated a cast-iron cylinder 30 cm long and 14 cm broad, in a wrought-iron jacket over a Bunsen burner to a temperature of 460 degrees C., as indicated by an air thermometer, and then observed its flat end in a dark room from a point 60 cm above it. When it had cooled to about 415 degrees the red heat vanished and gave away to an indefinite hazy glow. This glow completely disappeared at 404 degrees, and repeated observations gave an error of only 3 degrees. Highly emissive substances, such as the "mantles," made by Auer and others for incandescent gas lighting, became visible at the same temperature; but reflecting surfaces had to be heated 20 degrees higher before they appeared to the eye, and glass still more. These low temperature rays were found to traverse glass and water like ordinary light rays, but they suffer a comparatively greater absorption. Different eyes differ slightly in their capacity for seeing them, the maximum divergence being about 6 degrees But then the extent of surface must be the same. Mgr. Pettinelli found that if he screened off all but $\frac{1}{40}$th of the surface the body had to be heated 6 degrees higher than before to become visible.

Earthenware Accumulator Plates.

A somewhat peculiar type of storage battery was invented by George E. Hatch, of Quincy, Mass., in 1890, and covered by United States patents. Since the invention continuous experiments have been made with the battery by Mr. Hatch, both in the laboratory and in practical work, with a view to eliminating all possible defects and disadvantages, and the battery is now manufactured in its most improved form by the Hatch Storage Battery Company, 421 Chestnut Street, Philadelphia.

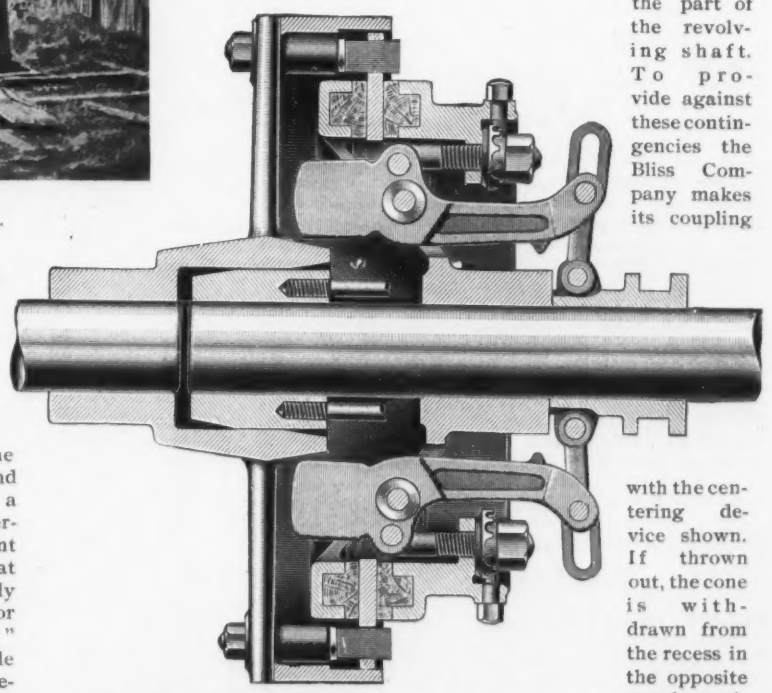
Mr. Hatch uses light, porous earthenware plates and places the active material upon them, clamping and binding the plates together by means of light wooden boards and flexible rubber bands. Between the earthenware plates are very thin lead sheets provided with lugs at the top which serve to form electrical connection between the elements. The advantages claimed for this method of construction are greater strength, lightness, elasticity, to allow for expansion and contraction, and the positive security and stability of the active material.

It is claimed that the battery is entirely unaffected by the jolting of street cars and railway trains, and that extremely heavy discharge rates do not affect its life or depreciation. This has been proven, the inventor states, by actual use with a car built purposely of great weight (something over sixteen tons) and run continuously for months. It is also stated that the claims made for the Hatch storage battery have been substantiated by constant service in the physical laboratory of Harvard College.

A New Friction Clutch Coupling.

The E. W. Bliss Company, of Brooklyn, N. Y., manufacturers of the Waldron flexible friction clutch pulleys, have adapted the principles of that clutch to a cut-off coupling, which we illustrate herewith, and which is identical with the flexible friction clutch pulleys made by the Bliss Company, so far as the clutch itself is concerned. A special feature is the centering device, which will be understood by an inspection of the cut.

It is a well-known fact that if two line shafts of moderate size are coupled by a cut-off coupling, when the coupling is thrown out of operation and one shaft allowed to remain at rest, the revolving shaft may not turn perfectly true with the stationary one. If there is no bearing provided to prevent this and hold the two shafts in line when coupled and revolving together, the shaft as a whole will have an eccentric motion, bringing injurious strains on the larger bearings and beltings. On the other hand, where such a bearing is provided, when the shafts are uncoupled the bearing is rapidly worn away on account of the tendency to eccentric motion on the part of the revolving shaft. To provide against these contingencies the Bliss Company makes its coupling with the centering device shown. If thrown out, the cone is withdrawn from the recess in the opposite member, allowing each shaft to take its natural position and re volve freely without any wearing surfaces. When the shifter is moved to throw the clutch into operation, before the friction rings grip the flexible plate, the cone brings the two shafts in alignment and insures the clutch and shafts revolving properly together.



SELF-CENTERING FRICTION CLUTCH COUPLING.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 2, 1895.

ELECTRIC STORAGE opened down on Monday and showed further signs of weakness Tuesday. On Wednesday the stocks tumbled to 50 and below, but subsequently rallied to 55 and 57 respectively for common and preferred. The decline has been attributed by some to the refusal of banks to accept the stock as collateral. There is a story current, however, to the effect that the rise and fall of these stocks were prearranged by insiders.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96⅛	98½
" " " Brooklyn	100	110	115
" " " Boston	100	..	152
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	53¾	..
Electric Storage, pref	100	56	..
General Electric	100	31⅛	31⅜
General Electric, pref	100	67	68
Westinghouse Consolidated, com	50	35	35½
" " pref	50	55	55½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	198	199
American District Telegraph	100	35	40
American Telegraph & Cable	100	94½	98
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	62	65
Gold & Stock Telegraph	100	105	..
New England Telephone	100	88	89
Postal Telegraph-Cable	100	..	..
Western Union Telegraph	100	90⅜	90⅞

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18	18¼
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11	14
" " pref	100	..	61
Buffalo St. Ry	100	83	85
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60
Columbus St. Ry	100	55	57
Consolidated Traction of N. J	..	25	..
Electric Traction, Philadelphia	50	65	65½
Hestonville	100	..	53½
Long Island Traction, all pd	100	19½	20
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	17	19
" " pref	100	68	70
North Shore Traction	100	33	35
" " pref	100	84	86
People's Traction $30 pd	25	58	58¼
Philadelphia Traction	50	75½	75⅞
Rochester St. Ry	..	34	37
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	19½	19¾
West End, Boston	100	69	69¾
" " pref	100	89	90
Worcester Traction	100	16	18
" " pref	100	87	89

BONDS.

Buffalo St. Ry. 1st con. 5s	100	108	110
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	100	102
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

THE TRACTION STOCKS have been offered down during the week in small lots, and on an almost total absence of supporting orders prices have declined throughout the entire list. The very few transactions that have taken place have been made in many cases at a decline of several points from the last previous sale. On the publication of the articles of incorporation of the new Buffalo Traction Company, Buffalo railway stock broke sharply, and although very few sales were made the price declined steadily to about 84½. The bonds, however, continue dull and firm. The reported purchase of the Steinway road by Philadelphia capitalists has caused the securities of that company to advance still further, and sales of the bonds are said to have been made as high as 112¼ and interest. Some large blocks of the stock are reported to have changed hands of late, but whether the control of the road has been transferred is not yet affirmed. The general uncertainty regarding the future of the various Brooklyn roads continues to be reflected in the price of the various securities. The successful termination of the suit of the Brooklyn Heights road to enjoin the city from enforcing the ordinance regulating the speed of the cars would mean largely increased earnings. The enforcement of the ordinance is said to be largely responsible for the decreased receipts, which are reported to have shrunk 10 per cent. of late.

NORTH SHORE TRACTION is just beginning to attract the attention its condition and prospects have merited for some time. In time Boston may look for considerable activity in North Shore Traction stocks as the country along the North Shore increases in population, and the preferred stock might be worth investors' study at the present time. The North Shore Traction Company controls its system by ownership of the $1,000,000 capital stock of the Lynn & Boston Street Railway Company, for which it paid $190 per share before several millions of dollars were poured into the system to change it over to electricity. As the preferred stock of the North Shore Traction Company is selling for less than this equity cost some years ago, information which may bear upon the relative values of the preferred and common stocks should just now be of interest. It is stated by the largest owners of the North Shore Traction Company that the corporation has no floating debt and has quick assets amounting to $103,000 in bonds and $125,000 of actual cash in the bank. At present the North Shore is paying 6 per cent. dividends upon $2,000,000 cumulative preferred stock. The proposition is now being considered to increase the capital stock of the Lynn & Boston from $1,000,000 to $2,000,000, and the North Shore Traction people believe that eventually the six or seven million invested in the Lynn & Boston properties will return to the North Shore Traction Company such earnings as will justify the faith of the original organizers. For the year ended Sept. 30, 1895, gross earnings were $1,376,144, an increase of $137,735 over previous year, and the net earnings were $575,211, an increase of $85,105. From the above are to be deducted taxes, rentals and interest on funded debt, aggregating $372,022, leaving a surplus of $203,187. At present only $100,000 is directly taken from these earnings (through 10 per cent. on Lynn & Boston stock) into the North Shore Traction Company's treasury, but the company has sufficient assets to continue the cumulative dividend on its preferred for many years, or until the Lynn & Boston capital is increased, as is proposed, to $2,000,000; but the Lynn & Boston surplus earnings are permitted to accumulate in its treasury, it will make a very handsome surplus for extensions, and to enhance the value of North Shore Traction stocks in the future. It is estimated that this year the Lynn & Boston will earn $1,500,000 gross, and have a surplus of $330,000 after payment of all charges, including North Shore Traction corporation expenses.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Nov. 4, 1895.

MR. JOSEPH WETZLER, of the editorial staff of *The Electrical Engineer*, was married on last Wednesday to Miss Pauline Gerson.

NICOLL THE TAILOR, who died recently, is said to have been the first business man in New York to use the electric light to illuminate his stores. He was one of the first to use the telephone in connection with his business.

STEINWAY RAILWAY SOLD.—It is stated that Philadelphia capitalists have bought out Cord Meyer and the New York and Long Island capitalists who were interested with him in the ownership of the Steinway Railway. The price paid for a controlling interest in the capital stock was not given out. Since the introduction of electricity and the consolidation of the separate small lines the business of the road has greatly increased.

THE TROLLEY IN POLITICS.—Electric traction was made to serve a somewhat unique purpose last week in Brooklyn. Dr. Wm. P. Wuest, candidate for Coroner in the Eastern District, and James D. Bell, candidate for the district-attorneyship, chartered a trolley car and fitted it out with transparencies and a brass band, and the car made a tour of the city every evening in the interests of these energetic politicians. The number of votes thus obtained has not been officially estimated.

PRESIDENT COCHEU'S GRANT RENEWED.—The Brooklyn Board of Aldermen last week renewed the grant made last year to the State Electric Light & Power Co., with the understanding that the company was to forfeit all moneys paid by it. Under the renewed grant this company agrees to

charge the city not more than 30 cents a lamp a day, and private consumers not more than 35 cents. It will also have to furnish a bond in $25,000 to carry out the terms of the grant

ELECTRIC SWITCHING ENGINES FOR THE BRIDGE.—President James Howell, Vice-President J K. Page, Seth L. Keeney and Clarence A. Henriques, the executive committee of the board of bridge trustees, met last week and discussed plans for switching the bridge cars by electricity. The board proposed: "That the chief engineer be instructed to advertise for proposals for switching the cars by electricity, and that the same be accompanied by plans and specifications showing how it is to be done; and that the bids for heating cars by electricity be also advertised for, and the aforesaid bids to be received by the executive committee by 12 o'clock noon on Nov. 11."

BROOKLYN ELECTRICAL SOCIETY.—The latest appliances for the measurement of electrical resistances was the subject of a lecture delivered by Mr. Otto T. Louis, of Queen & Co., Philadelphia, before the Brooklyn Electrical Society, on Tuesday evening, Oct. 29, in the Edison Assembly Rooms, Brooklyn. Mr. Louis described at length all the more important resistance testing instruments, and a new form of American standard, which is advanced as an improvement on the British Association unit. The lecturer also described and exhibited a new bridge capable of measuring resistances as low as that of three-quarter inch bar copper. At the close of the lecture Mr. Louis made several donations to the society.

I. P. FRINK, 551 Pearl Street, is busy—exceedingly and profitably busy. That this should be true does not excite any particular wonder in the minds of those who are familiar with the quality of Mr. Frink's product, which virtually "sells itself." Besides a lot of minor sales, the following buildings have recently been equipped throughout with Frink reflectors: St. Mathew's Lutheran Church, Hanover, Pa.; Holy Trinty Church, McSherrystown, Pa.; Baptist Church, Elberton, Ga.; M. E. Church, Quitman, Ga.; Baptist Church, Franklin, O.; drill hall, Twenty-third Regiment Armory, Brooklyn, and the establishments of Messrs. M. Knoedler & Co., 355 Fifth Avenue, New York; Arthur Tooth & Son, 297 Fifth Avenue, New York; H. C. Frick, Pittsburg, Pa., and the art galleries of Carnegie Library, Pittsburg, Pa.

JOHN C. DOLPH, 126 Liberty Street, Eastern manager for the Forest City Electric Company, is distributing copies of a handsome catalogue of "Roll drop" commutator segments which will be of great assistance to those having occasion to order bars for building and refilling commutators. The catalogue contains full size cuts of all the standard commutator bars now in use on railway motors, with specifications as to width of bar, number of divisions and weight of complete sets, which enable the purchaser to see at once what he needs and what it will cost. A later catalogue will be issued containing a list of standard bars for dynamo commutators. Roll-drop bars stand in great favor with the Eastern trade, their intrinsic merit and Mr. Dolph's excellent business qualifications and wide popularity forming a combination which could scarcely fail to achieve wholly satisfactory results.

PHILADELPHIA NOTES.

OFFICE OF THE ELECTRICAL WORLD,
927 Chestnut Street, Nov. 2, 1895.

LARGE & TWINING, 321 Chestnut Street, report Fall trade improving.

J. GRANT HIGH, 123 North Third Street, says he finds business very good, so much so that his company is behind on its orders.

FRANK H. STEWART & CO., electrical supply dealers, 35 North Seventh Street, have issued a very neat and tasteful catalogue descriptive of the various electrical specialties and supplies which the firm handles.

CHARLES HEWITT, who has been identified with the Electric Traction Company for some time past, has been appointed chief electrician of the Union Traction Company, which position he is eminently qualified to fill.

THE HORN & BRANNEN MANUFACTURING COMPANY, manufacturer of gas and electric fixtures, whose factory was burned down a few weeks ago, is now in full operation, employing 175 hands. Its salesroom is temporarily located at 211–213, and factory at 427–433 North Broad Street.

CHARLES WIRT, "Dynamo Doctor," has removed to a more central location at 1026 Filbert Street, where he will dispense the Wirt brush specific, which has been known to cure the worst cases of commutator smallpox. A great many engineers have been cured of "that tired feeling" by the use of this remedy.

THE PENNSYLVANIA STEEL COMPANY, manufacturer of steel rails, etc., formerly located at 208 South Fourth Street, has moved its offices to the Girard Building, corner Broad and Chestnut Streets, where it occupies a fine suite of rooms. The present location of this company is a very desirable one, being only one block from the Pennsylvania Railway depot, rendering it possible for out-of town parties to get a business interview between trains.

MR. CHAS. MILLER, recently assistant master mechanic of Thos. A. Edison's ore concentrating works, at Edison, N. J, and formerly the superintendent of the Novelty Electric Works of Philadelphia, has associated himself with Sheble & Patton, electrical engineers and contractors, 1026 and 1028 Filbert Street, taking one-third interest in the concern. Mr. Miller states that he has some new electrical specialties which he has recently patented and which he will shortly introduce.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Nov. 1, 1895.

THE PUMPELLY-SORLEY STORAGE BATTERY COMPANY has been absorbed by the Electric Storage Battery Company of Philadelphia. The former company was organized in April, 1893, by Mr. B. J. Arnold, formerly of the General Electric Co., and constructing engineer of the Intramural Railway at the World's Fair. After repeated requests by Messrs. Pumpelly and Sorley to take hold of this matter he finally consented to organize the company, and just got it fairly well started when the panic came on, which was weathered successfully, although the company proved a heavy load to its promoters. In Feb., 1895, just as it had secured a large telephone contract and had installed new machinery in the plant to turn goods out systematically and cheaply, their factory was destroyed by fire, leaving them practically where they began, except that the reputation of the battery had been established. Within three hours from the time the fire started a new factory was rented and preparations made for equipping it, resulting in the opening of a new factory and the securing of large contracts sufficient to make it a money-making investment up to the time of the purchase. It had on hand many large contracts, among which were the Chicago Telephone Company, the St. Joseph & Benton Harbor Electric Railway, Light & Power Company, the Chicago Board of Trade and others, the latter cells being installed in connection with electric elevators, a measure which will probably be a pioneer in this class of work. These plants will be installed under Mr. Arnold's direction as consulting engineer of the companies, so that the purchase will have no effect upon the installation of the plants. The absorption of the Pumpelly-Sorley Storage Battery Company by the Electric Storage Battery Company practically gives the latter control of all the important battery patents in the United States. It is understood that Mr. Arnold made a comfortable fortune out of this transaction.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Oct. 23, 1895.

ELECTRIC TRACTION IN MANXLAND.—The electric company between Douglas and Laxey has proved such a success that the Manx people have evinced a strong desire to have their other towns connected together by a network of electric lines, and several projects are being discussed at the present time. It is rumored that the Isle of Man Tramways Company, which owns the Douglas-Laxey line, intends to purchase the existing steam line between Douglas and Peel, to convert it into an electric line, to connect it with the Douglas-Laxey electric tramway, and to extend this latter northward as far as Ramsey, thus making a through communication by electric railway between Ramsey in the north and Peel in the south of the island.

ELECTRIC TRACTION AT LEEDS.—The Leeds Town Council came to an important decision on Tuesday last, by adopting, by 40 to 11 votes, a principle of electric traction for the entire tramway system of Leeds, which was recently acquired by the Town Council. As soon as the tramways were acquired by the City Council a special committee was appointed to go into the entire question of what method of mechanical traction should be adopted by the municipal lines, and this committee recently presented a most exhaustive report, compiled under the ægis of Mr. Hewson, the borough engineer. This report was temporarily summed up by Mr. Alderman Firth, in his introductory remarks at the meeting on Tuesday last. He said that as soon as the tramways came under the management of the municipality it was generally felt that a more humane system of traction than that by horses would have to be adopted. Steam haulage, it was felt, could not be tolerated any longer, and gas and oil cars the special committee were unanimously of opinion would not do for Leeds. There only remained to be considered cable and electric traction, a combination of the two systems being impracticable. The estimate of the borough engineer for the initial cost of cable and electric traction was £429,000 and £378,000, respectively, the estimated working cost being respectively £112,000 and £90,900. The lack of flexibility of the cable system as regards speed and erection was dwelt upon, and the standard of success which the overhead trolley system had met within the United States, was made much of. In the discussion which followed the presentation of the report, several members stated that they had entered into the matter by asking favor of cable traction, and the opposition to the adoption of the report was very able, the most ingenious reasons being urged for delay. Several members thought that a tramway expert should have been consulted. This, however, did not find much favor with the members of the special committee. Mr. Alderman Ward stated that "so many experts had been offering their services that the committee had found them a nuisance." Mr. Alderman Firth gave it as his opinion that "a committee of experts would not present a report in twenty years." Several other members urged delay until the November municipal elections were over. In the end, however, the principle of electric traction won the day, as I have mentioned. The large expenditure indicated above, however, is not to be made immediately. Short lengths of lines on the overhead trolley and the underground conduit systems are to be pitted one against another before the final decision as to method is arrived at. The decision of the Leeds City Council is undoubtedly the most important step in advance in regard to the development of electric traction in this country that has as yet been taken.

General News.

TELEGRAPH AND TELEPHONE.

SPRINGFIELD, ILL.—E. H. Brainerd is interested in the forming of a new telephone company.

LA GRANDE, ORE.—La Grande Ronde Telephone Company proposes putting in a telephone system here.

PAINESVILLE, O.—The Painesville Telephone Company is prepared to receive bids for the construction of its exchange.

TYRONE, PA.—The Phœnix Telephone Company, of Altoona, has been granted permission to establish wire lines and erect poles here.

LA GRANGE, N. C.—W. R. Simmons is making investigations with a view to building a telephone line from La Grange to Seven Springs.

BROCKTON, MASS.—The Southern Massachusetts Telephone Company will accept the franchise for building and acquiring of underground conduits for its wires.

BRATTLEBORO, VT.—Poles are being distributed for a telephone line between this place and North Adams, Mass., by way of Wilmington.

JEFFERSON, GA.—A charter has been granted to a company to build a telephone line from Jefferson, Jackson County, to Athens, and work will be begun at once.

NORWALK, CONN.—The Norwalk Mutual Telephone Company has filed a certificate of organization. Levi Warner, George W. Cowles and George W. Coy are the subscribers.

LARAMIE, WYO.—A movement is again in progress to establish a telegraph and telephone line between Laramie and Walden, in North Park. The board of trade of Laramie can furnish particulars.

RAHWAY, N. J.—The common council has granted a two months' extension of time to the Rahway Mutual Telephone Company for the completion of arrangements for operating its system here.

EAST LIVERPOOL, O.—Spencer F. Quick, of Steubenville, is organizing a company of East Liverpool and Wellsville capitalists to extend the lines of the Phœnix Telephone Company, which is now putting up wires in Steubenville.

YOUNGSTOWN, O.—W. C. Cherry, general manager of the Bell Telephone Company, of Columbus, has been in Youngstown conferring with the city commissioners regarding the granting of a franchise to the new telephone company.

CAPE MAY, N. J —Wm. Boston, a government telephone expert, is at Cape May completing a survey for a telephone circuit which will extend from South Atlantic City to Cape May Point, connecting all of the intermediate life-saving stations.

NEW CASTLE, PA.—The local Bell Telephone Company has reduced its rates to $27 for business houses and $17 for residences, in order to fight the New Castle Telephone Company, which had adopted $30 for business houses and $20 for residences.

REDWOOD CITY, CAL.—At a session of the Board of Supervisors, held Oct. 8, W. F. Shelley applied for a franchise to operate a system of telephone lines throughout San Mateo County; he also plans to establish a local telephone exchange at Redwood City.

ROCKVILLE, MD.—The officers of the Chesapeake & Potomac Telephone Company have made application to the Mayor and Council of Rockville for permission to erect poles and string wires from the southeastern limits of the town to the Montgomery Hotel.

ANTIGO, WIS.—J. T. Jensen, of Milwaukee, has been in this city, in the interest of the Wisconsin Telephone Company, obtaining contracts from the citizens to insure the success of the exchange. He secured enough signatures and the lines will be built immediately.

Electric Light and Power.

ARCADIA, WIS.—The Arcadia Milling Company will put in an electric light plant.

HEYWORTH, ILL.—The electric light plant owned by J. L. Humphrey has been destroyed by fire.

PATERSON, N. J.—The Passaic Light Company will soon begin work on a new building to cost $100,000.

NUNDA, WIS.—The authorities have granted a franchise for an electric light plant. The town clerk can furnish particulars.

ATLANTA, IND.—A local electric light company is to be organized to light the town. The Mayor can probably furnish further particulars.

CANNON FALLS, MINN.—Cannon Falls people are agitating the question of issuing bonds in the sum of $2,000 to put in an electric light plant.

MENASHA, WIS.—the Common Council has let the contract for lighting the city by electricity to the Neenah & Menasha Gas & Electric Company.

CLEVELAND, O.—The Union Power Company, J. H. White, F. C. Chamberlain, capital $50,000, will produce and furnish electric power for all purposes.

PRESTON, MINN.—At an election held to ascertain whether an electric light plant and water works should be put in, the vote stood 151 to 58 in favor of the plant.

CORUNNA, MICH.—At a special election recently held the proposition to bond the city in the sum of $30,000 for waterworks and an electric light plant was carried.

ROME, N. Y.—The executive committee of the board of managers of the Rome State Custodial Asylum has decided to advertise for bids for electric lighting facilities.

FLUSHING, L. I., N. Y.—The Board of Trustees has instructed the light and water committee to advertise for bids for lighting Main Street and Broadway with arc lights.

NIAGARA FALLS, N. Y.—The Clifton Electric Light Company will build a power house of brick, 80 x 100 feet, to cost about $10,000, and to install new machinery to cost $25,000.

TOPEKA, KAN.—A resolution has been adopted by the Council authorizing the city clerk to advertise for bids for machinery to increase the capacity of the city electric light plant.

CLEVELAND, O.—Charles E. Togles is interested in the organization of a new light and power company, with a capital stock of $60,000, to be known as the West Side Electric & Power Company.

SHELBYVILLE, IND.—The property and franchises of the Indiana Water & Light Company have been sold to Geo. H. Halt, of New York, for $75,000. The Warsaw plant was also bought by Mr. Halt for $40,000.

WHATCOM, WASH.—Skillings & Connor, of Seattle, have prepared plans for the normal school building, to be erected at Whatcom. The building will be provide d with electric clocks and other electrical equipment.

KANSAS CITY, MO.—The Karnival Krewe Committee on Lighting proposes to expend $15,000 for lighting the city during the carnival week. The committee on street illumination consists of John Sullivan, W. W. Cowan and George P. Gloss.

DAVENPORT, IA.—The gas and light committee and the Board of Public Works have been ordered to advertise for proposals for the lighting by electricity of the city, for a term of five years, commencing June, 1896.

DETROIT, MICH.—Gilbert Wilkes, consulting electrical engineer, has advised the Board of Education that it will be more economical to have a separate lighting plant for the new high school building than to light the buildings from the city's central station.

NIAGARA FALLS, N. Y.—W. W. Gibbs, president of the Electric Storage Battery Company, of Philadelphia, has been in Niagara Falls, and together with Vice-President Wickes, of the Power Company, looked over sites with a view to locating a manufacturing plant here.

EVELETH, MINN.—O. D. Kinney has made a proposition to the village of Eveleth, to put in six arc lights at a cost to the village of $60 per month. He asks for a franchise for a short time, and it is understood to be his intention to supply the mines in the vicinity of Eveleth with lights.

GOUVERNEUR, N. Y.—A new electric light company is about to be organized for the purpose of competing with the present plant for both street and private lighting. The new plant will be erected in the building of the St. Lawrence Manufacturing Company, recently purchased by J. H. Abbott, and will be operated by water power, A. L. McCrea, J. H. Abbott and others will compose the company.

DANSVILLE, N. Y.—The Dansville Electric Light Company and Gas Works have consolidated, and will run under the name of the Dansville Gas & Electric Light Company. The directors are Charles H. Rowe, William A. Spinning and William Kramer, all of Dansville. The electric light plant which is now situated just back of Main Street will be removed to Ossian Street, in a lot adjoining the gas works.

MILWAUKEE, WIS.—The committee on municipal lighting has decided to contract with the Milwaukee Street Railway Company for five years at $92 for lights on the overhead system, and $109 for those where the wires are underground, with the exception, conceded by the company, that all lights attached to the latter system located outside of the two-mile limit are to be charged for at the rate of $92, saving to the city the difference of $17 each on about 100 lamps. The ordinance requiring all wires to be buried within six years will be repealed. This arrangement is deemed a liberal one on the part of the company, and is acceptable to the committee.

The Electric Railway.

UTICA, N. Y.—At the last meeting of the Council a franchise was granted to the Belt Line Railway.

ST. PAUL, MINN.—The Fourth Street & Shelby Avenue Railway Company will change its motive power to electricity.

WOONSOCKET, R. I.—It is stated that work on the Blackstone extension of the Woonsocket Street Railway will be commenced at once.

WOOSTER, O.—The County Commissioners have granted the Wooster, Medina & Cleveland Electric Street Railway Company a franchise through Wayne County.

ST. LOUIS, MO.—It is rumored that the cable system of the People's Railway will be taken out next year and an underground conduit electric system put in its place.

MANCHAUG, MASS.—Hon. James W. Stockwell is among the promoters of a projected electric railway from East Douglas via this place and Sutton Centre to Milbury.

BRISTOL, PA.—Petitions are being signed by property owners, from Torresdale to Bristol, for the Holmesburg & Bristol trolley railway to be extended to Bristol.

SIOUX CITY, IA.—An ordinance has been passed granting to the Sioux City Bridge Company the right of way above and across a part of First Street for the purpose of laying railway tracks.

SHAEFFERSTOWN, PA.—The citizens of Schaefferstown and vicinity have subscribed approximately $45,000 toward the extension of the Reading & Womlisdorf electric railway to this place.

SKANEATELES, N. Y.—A franchise has been granted by the village trustees to the Auburn Interurban Railway Company permitting the operation of of an electric railway through the village.

LITTLE FALLS, N. Y.—The Little Falls Street Railway Company has made application to the Common Council for consent to construct and operate a street surface railway upon certain streets of the city.

PETERSBURG, VA.—The Petersburg Street Railway and Petersburg & Asylum Railway are to be sold by order of the court on Jan. 22, 1896. It is said there are liens on the two properties aggregating $130,000.

CLEVELAND, O.—The Big Consolidated Street Railway Company has been granted permission to construct and operate an extension to its lines through Pearl Street out to the corporate limits of South Brooklyn.

WATKINS, N. Y.—The directors of the Watkins & Havana Railway Company have decided to continue the proposed electric road from Havana to Horseheads, to connect with the Elmira & Horseheads Road.

NEW HAVEN, CONN.—The Winchester Avenue Street Railway Company has voluntarily increased the wages of 140 of its motormen and conductors; the increase ranges from two and a half to five cents an hour.

GRAND RAPIDS, MICH.—The Consolidated Street Railway Company has received a petition from the citizens of Oakdale Park and vicinity, requesting the company to extend its Madison Avenue line to that locality.

ASBURY PARK, N. J.—The Asbury Park, Bradley Beach, Belmar & Spring Lake Railway Company, proposed to build southward from Asbury Park, and it is said the road is eventually to be extended to Atlantic City.

DOYLESTOWN, PA.—The Delaware & Schuylkill Traction Company has applied for a charter. Among those interested are Francis Fennimore, William J. Fell, M. S. Lynch, Robert C. Fulton and Samuel A. Hamilton.

NIAGARA FALLS, N. Y.—Another street railway company is seeking to obtain a franchise from the city.

JERSEY CITY, N. J.—Chancellor McGill has appointed J. W. Wainwright, of Manasquan, receiver for the South Jersey Street Railway Company. The company is indebted to the amount of $145,000 and has $50,000 of assets.

WILMINGTON, DEL.—There is talk of building an electric railway from Wilmington to Oxford. Secretary Stubbs, of the Oxford (Pa.) Board of Trade. and J. Mortimer West, Jr., civil engineer, Philadelphia, are interested.

NORWALK, CONN.—The Tramway Company, of Norwalk, whose charter gives it the privilege of building a trolley line from Norwalk to New Canaan, has made a preliminary survey over the main road between the two points.

UNION, N. Y.—A seven-mile electric road connecting this place and Main is contemplated. It will pass, as well, through the village of Union Center. The projectors of the Union & Lestershire road have the matter under advisement.

WENHAM, MASS.—General Manager E. E. Foster and Superintendent Page, of the Lynn & Boston Railway, have been in conference with the Board of Selectmen of Wenham, in reference to equipping the Wenham line with electricity.

CLEVELAND, O.—The Cuyahoga Suburban Railway Company is ready to accept the franchise for its South End road, which was recommended by the board of control to the City Council, and will proceed promptly upon receipt of the papers.

HAMBURG, N. Y.—The Hamburg Railway Company has filed with the secretary of state a certificate of an extension of its route along the Ridge road, 1,000 feet from White's Corners road, westerly; thence over private property to Blaisdell.

GEORGETOWN, D. C.—The Georgetown Barge, Dock, Elevator & Railway Company has been granted permission to build a double railway track on Water Street from Aqueduct Bridge to Rock Creek, and work will be commenced immediately.

OWOSSO, MICH.—The City Council has granted a 30-year franchise to the Owosso & Corunna Traction Company. The road will be extended over several streets in Owosso, and new cars and electrical equipment used. Work will be begun at once.

TARRYTOWN, N. Y.—A. J. McKee, of Tarrytown, has filed an application for the right to construct and maintain an electric railway in the village. It was referred to a committee consisting of Trustees Maginey, Field and Wright, who have under consideration a petition of M. P. Hillyer, of New York, to build a road.

ISLIP, L. I., N. Y.—The Town Board, on Oct. 23, voted to grant a franchise to ex-Justice George B. Studley and Alexander B. Martin, representing a syndicate of New York capitalists, who agree to build and conduct the trolley system from Oakdale to the western boundary line of the town. The franchise calls for the completion of the road within two years.

LIMA, O.—A company has been organized, to be known as the Lima & Piqua Electric Street Railway Company, and it is proposed to build a line from Lima to Piqua. The company will also furnish electric light, heat and power to the cities through which the road passes. B. C. Faurot, D. W. Jay, D. Armstrong, Wm. H. Hartman, S. W. McFarland and Edward Purpus are interested.

Trade and Industrial Notes.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Kokomo, Ind., reports the installation of the following new exchanges: Altoona, Pa., 400 telephones; Middletown, N. Y., 200 telephones; Cairo, Ill.. 300 instruments; Tyrone, Pa., 100 instruments; Holidaysburg, Pa., 100 instruments; Fall City, Neb., 100 instruments; Point Pleasant, W. Va., 50 instruments, and Madison, Ind., 200 instruments.

SOME HANDSOME OFFICE DESKS are illustrated in advance sheets which the Ithaca Desk Company, of Ithaca, N. Y., is distributing; among these that appeal particularly to lovers of fine office furniture are two combination roll-top desks and filing cabinets which are models of convenience and splendid woodwork. The company will soon issue a complete catalogue of its numerous styles of office desks, filing cases, etc.

J. M. WATROUS, 521 Race Street, Cincinnati, O., has issued a handsome illustrated catalogue of foot power machinery and small tools, which will be welcomed by every one who has use for this class of goods and wishes to be sure of the quality. Among other very convenient tools is a new Card "Handy" screw plate, a mere glance at the picture of which fills the reader with a strong desire to possess forthwith a pair of these appropriately named articles.

THE ELECTRIC APPLIANCE COMPANY SPREADS OUT.—The Electric Appliance Company is making some radical changes in the arrangement of its building at 242 Madison Street, Chicago. The general office now occupies the second floor, leaving the entire first floor for the store and shipping room. The company now occupies the entire building at 242 Madison Street, four floors, with floor space of about 20,000 square feet, and claims to have the largest building in the West which is entirely and exclusively devoted to electrical supplies.

THE RUETE CONDUIT COMPANY, which has just completed its organization, has opened offices in the Havemeyer Building, New York, and is prepared to quote prices on its new iron-armored conduit. Mr. Frederick Noll, the manager of sales of the company, has had an extensive experience in this class of work, and is widely known in electrical circles. Mr. Ruete, the inventor of the new conduit, has embodied in it many improvements and important modifications suggested by his wide practical experience in conduit manufacture. The conduit has been approved by the National Board of Underwriters. The company has already secured some gratifying orders, and reports the outlook as very encouraging for a large volume of business in the near future.

AN INTERESTING CATALOGUE has just been published by the Water Circulating Grate Company, of 1026 Filbert Street, Philadelphia, in which is described the Reagan water grate, manufactured by this company. This grate consists of a number of heavy 2-inch tubes, arranged lengthwise of the boiler and connected with the source of water supply so that the feedwater circulates through them before reaching the boiler. "Choppers" are located between the tubes and are manipulated by levers at the front of the boiler, their action being such as to "break up" the fire. Besides the description of the grate, a quantity of useful engineering information is given, which makes the catalogue a very handy reference book. The description of the grate is profusely illustrated.

A SPECIAL EDITION catalogue of pumps, condensers and meters has been published by Henry R. Worthington, of Brooklyn, for distribution at the Atlanta Exposition. The catalogue is a most comprehensive one, and includes, besides all the standard Worthington machinery, a large number of special pumps—wet and dry vacuum pumps, geared power pumps, direct-connected electric pumps, combined automatic feed pumps and receivers, etc. The book provides a carefully devised telegraphic code, which will be found particularly convenient, not only in ordering, but in making inquiries, etc. The Worthington exhibit at the Atlanta Exposition attracts a great deal of attention, and gives visitors a good idea of the exceptional facilities possessed by the Worthington Works for producing pumping and kindred machinery of the highest grade. The Worthington product is so widely known and thoroughly established that the exhibit was not necessary for "missionary" work, but was the outcome of the progressive policy which has placed the manufacturer in the front ranks of industrial establishments.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 29, 1895.
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

548,627. ELECTRIC TRACTION; E. Chabeault, Marseilles, France. App. filed Aug. 17, 1894. The combination of a current furnisher including contacts, a cover, perforated rod and a piston and the cylinder in which the latter moves.

548,660. JUNCTION BOX AND MODE OF LINING SAME; W. T. Ruete, New York, N. Y. App. filed Feb. 26, 1895. A method of lining which consists in securing by means of paste a thin layer of paper or other material and then treating the same by immersing the lined box in a highly heated bath of various compounds.

548,662, filed May 2, 1895; 548,683, filed June 8, 1895; 549,083, filed March 6, 1895. ELECTRIC ARC LAMP; M. Wheeless, Washington, D. C. The combination of a solenoid and its core for establishing the arc and also actuating the carbon holder, a hinged or gripping dog carried by the holder and carrying a carbon, and a vertically movable controlling rod connected to the stem of said dog, and a stop for limiting the movement of the controlling rod in each direction.

548,669. INSULATOR PIN; C. W. Stephen, Camden, N. J. App. filed Feb. 9, 1895. A pin consisting of a tapering sleeve of insulating material having a thread to receive a cap, a longitudinal opening, a bolt passing through the opening and a cross bar, means for tightening the same in place, the opening in the sleeve being slightly larger than the bolt.

548,684. DYNAMO ELECTRIC MACHINE; N. Whichello, Chicago, Ill. App. filed July 18, 1895. A machine whose armature is composed of a plurality of non-ferruginous coils, combined with a flat or curved core having its edges V-shaped and interwrapped with insulating strips and conforming to the shape thereof.

548,700, filed April 8, 1895; 548,701, filed May 25, 1895. INDICATOR FOR ELECTRIC CURRENTS; A. C. Crehore, Hanover, N. H. A recorder consisting in polarizing a beam of light, resolving it into the colors of the spectrum, rotating the plane of polarization by the action of a current and photographing the various positions of the band, thereby showing the strength of the current.

548,709. POLYPHASE ALTERNATING-CURRENT MOTOR; F. S. Hunting, Fort Wayne, Ind. App. filed March 14, 1893. A motor having a primary and a secondary winding, the latter being a polyphase one, the coils of each being sectional and distributed on the core so that the secondary electromotive forces in the several sections of a branch will be in the same phase.

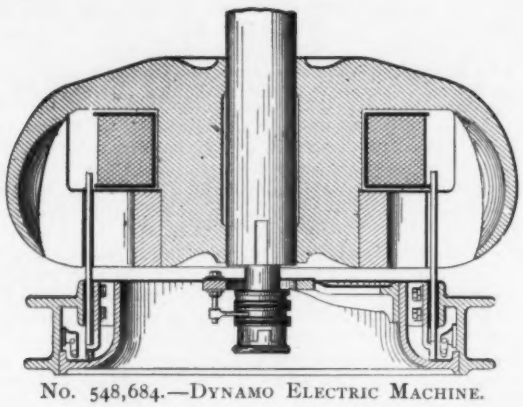
548,729. TELEGRAPH; G. S. Tiffany, Highland Park, Ill. App. filed March 16, 1894. The combination of a paper shifter controlled by a magnet, two cuts located in the circuits and adapted to open one circuit and close the other, and electrical devices at a station to control the condition of the two paper shifters.

548,730. DRY BATTERY; J. T. Todd, Tuscola, Ill. App. filed Feb. 8, 1895. The combination of a vessel having positive and negative electrodes disposed therein, and a lining of pulp to insulate the walls and the two electrodes, and a removable stopper adapted to be sealed into one end of a hollow electrode, so that moistening may be introduced.

548,744. ELECTRIC SWITCH; J. C. Cassidy, East Orange, N. J. App. filed July 19, 1895. The combination of a frame having two collars thereon, a rotary shaft having a handle and openings for a rotary wheel, and a revolving block, and a row of contacts adapted to be brought into communication when the shaft is revolved.

548748. MICROPHONE; L. M. Ericsson, Stockholm, Sweden. App. filed July 6, 1895. The combination of a casing, a vibrating diaphragm, and a supplemental protecting diaphragm between the vibrating one and the mouth piece consisting of silk impregnated with lacquer or other like substance.

548,755. ELECTRIC METER; R. O. Hood, Danvers, Mass. App. filed March 9, 1895. The combination of a motor placed in the circuit to be measured, means for intermittingly retarding the speed of the movable part of the motor when it reaches a certain velocity, until it reaches a certain low velocity, and means for recording the same.



No. 548,684.—DYNAMO ELECTRIC MACHINE.

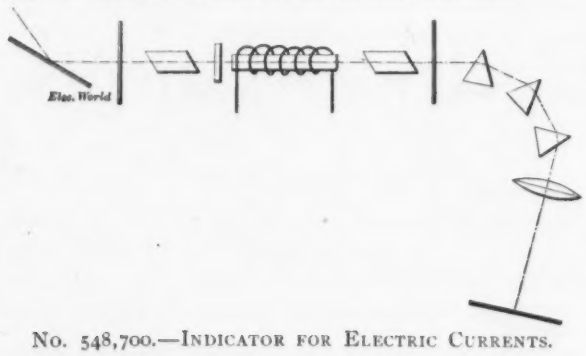
548,777. ELECTRODE FOR APPLYING ELECTRIC CURRENTS; E. F. Davis, West Caton, N. Y. App. filed June 10, 1895. An apparatus consisting of a helmet-shaped head electrode lined with absorbent material, and adapted to be strapped in place and bring the electrode in contact with the head, and a second electrode to be in contact with another part of the person.

548,786. UNDERGROUND ELECTRIC RAILWAY; H. B. Nichols and F. H. Lincoln, Philadelphia, Pa. App. filed March 11, 1895. The combination of a conduit having a conductor therein, a drain connected with a culvert or otherwise adapted to collect moisture accumulations, and means for inducing suction to assist in the discharge to the culvert.

548,789. DISTRIBUTION SYSTEM FOR ALTERNATING CURRENTS; A. L. Searles, Brooklyn, N. Y. App. filed April 18, 1895. A system consisting of a plurality of transformers, one of which is normally in circuit, a solenoid controlled by energy flowing through the latter, a snap switch, two electromagnetic devices alternately actuated by the switch for cutting in or out of circuit, an auxiliary transformer when current exceeds or falls below a certain point.

548,819. ELECTRIC SWITCH; H. Ross, Providence, R. I. App. filed July 17, 1895. A switch consisting of two conducting members located in different planes, a tie of non-conducting material being connected to each, and a handle fastened to the tie, and through which the members are operated simultaneously. 548,629 filed March 22, 1895.

548,830. AUTOMATICALLY CONTROLLING ELECTRIC POWER; F. E. Herdman, Winnetka, Ill. App. filed June 28, 1895. The combination of an electric motor and a supply of current, a device controlled by the motor and adapted after a certain number of revolutions of the motor to increase the strength of current independent of the operating mechanism.



No. 548,700.—INDICATOR FOR ELECTRIC CURRENTS.

548,867. RHEOSTAT ELEMENT; H F. Davis, Pittsburg, Pa. App. filed Feb. 28, 1894. A resistance composed of a support and discs strung thereon, alternate discs being plane and bent at one or more points.

548,887. AUDIBLE ALARM FOR VALISES; W. F. Murphy, Charleston, S. C. App. filed Aug. 30, 1895. The combination of a satchel or other article with a small hole in the bottom thereof, an electric circuit including a bell or buzzer and a battery, a hand-operated switch and a circuit-breaker provided with a pin which projects through the said hole in the bottom of the article.

548,897. TELEPHONE SWITCH; J. E. Thomas, Cleveland, O. App. filed April 17, 1895. The combination of a rotary reciprocating shaft hooked at one end and provided with a disc at the other, means for imparting a double motion thereto, and contact points arranged to alternately bear on opposite sides of the disc.

548, 903. MACHINE FOR WINDING COILS; J. J. Wood, Fort Wayne, Ind. App. filed March 17, 1894. The combination of an automatic counter, a stationary dial plate, a hand revolving around the plate having a trip pin, gearing for driving this hand from the winding shaft, and an alarm bell mounted on a hammer arm and adapted to be engaged by the trip pin.

548,904. AUTOMATIC TIME CUT-OUT; F. B. Badt, Chicago, Ill. App. filed Sept. 24, 1894. A circuit making and breaking device consisting of two mercury tubes with conductors leading thereto, a coil about one of them, and a conductor supported at one end of a float in one tube, its other end in proximity to the mercury in the other tube.

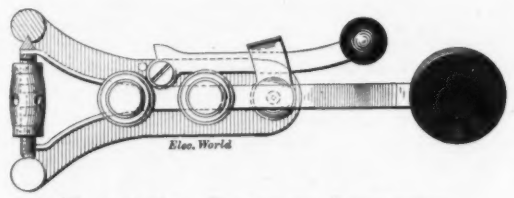
548,924. ELECTRIC TRAIN SIGNAL; M. W. Parrish, Detroit, Mich. App. filed Dec. 24, 1894. A signaling system consisting of a circuit having separated contiguous circuit terminals projecting vertically from a horizontal base with a signal in the circuit, a closed circuit with signaling circuit-breakers therein at points from which the signal is to be sent, and an armature lever adapted to operate to intermittingly contact with said circuit terminals by a diminution of the electric energy, and to make positive contact by operating a circuit-breaker to break the closed circuit.

548,930. TURBINE ELECTRIC GENERATOR; C. E. Sargent, Chicago, Ill. App. filed Sept 19, 1894. An electric generator consisting of an armature provided with a series of vanes and suitable ports and supply pipes for delivering a gas at great velocity against the vanes and for receiving the discharge therefrom.

548,949. SAFETY AND LIMIT SWITCH FOR ELECTRIC MOTORS; G. F. Card, Mansfield, O. App. filed Aug. 21, 1895. An electric motor having a cut-out switch with its core projecting at both ends and forming two poles adapted to co-operate with two independently mounted armatures and release the switch when abnormally increased or decreased current energizes the magnet.

548,968. AUTOMATIC CIRCUIT-BREAKER ALARM; J. H. Devine, Johnstown, Pa. App. filed Nov. 13, 1894. An alarm consisting of an insulated base carrying a bracket, reversely bowed spring contact plates, and having their free ends overlapping and normally sprung apart, and an insulator block fastened on the free end of one of the contact plates, and adapted to be engaged by the falling switch arm of an automatic circuit-breaker.

548,969. TELEGRAPH INSTRUMENT; O. A. Dickinson, Arverne, N. Y. App. filed July 13, 1895. The combination of trunnion points, an adjustable nut and lock nuts with a lever and trunnion posts, preventing the lever working loose. and thus causing poor contact.



No. 548,969.—TELEGRAPH INSTRUMENT.

548,976. CLOSED CONDUIT ELECTRIC RAILWAY; M. F. Flynn, Stamford, Conn. App. filed Nov. 27, 1894 The combination of a closed conduit, line wires therein and switches engaging the wires, striking cams on the conduit to operate the switches and a laterally moving arm to also be brought into contact by the said switches.

548,997. ELECTRIC MOTOR CAR TROLLEY; J. M. Kennedy, Hollidaysburg, Pa. App. filed May 31, 1895. A car having an overhead trolley and means within the car for shifting said trolley, lookouts in the top of the car, and a light-giving appliance carried upon the trolley mechanism without the car, for lighting the trolley and wire.

549,023 and 549,079. SECONDARY BATTERY PLATE AND METHOD OF PREPARING IT; J. J. Rooney, Brooklyn, N. Y. App. filed April 1, 1895, and July 22, 1895. A battery consisting of a grid of press board paper, with the sizing removed, rows of perforations therein active, material to become active, filling the perforations, and conducting strips, each being in contact with the active material in one row of perforations.

549,045. ELECTRIC BURGLAR ALARM; M. Anthony, Streator, Ill. App. filed Feb 14, 1895. An alarm consisting of a maker and breaker of circuit secured fixedly at one end to opposite sides of the window casing, and adapted to be operated through an opening in said casing, so as to bring the free ends of the device into contact with each other when acted upon by raising or lowering the window.

549,061. INDIRECT CONTROL OF MOTORS; G. S. Dunn, New York, N. Y. App. filed Aug. 12, 1895 The combination of a motor, means for supplying a constant current to the armature, and also means for supplying to the field coils a constant potential current.

549,074. Filed April 25, 1895. 549,075. Filed April 30, 1895. ELECTRIC ARC LAMP; R. & H. Niewerth, Berlin, Ger. The combination of a stationary lower carbon, a movable upper one, a main lever actuated by a solenoid, a drum on the opposite side of the lever, a regulating mechanism connected with the drum and a band from which the upper carbon is suspended, the said band being applied at one end to the drum and connected with the opposite end of the main lever.

549,091. TROLLEY FOR ELECTRIC RAILWAYS; J. Hess, Scranton, Pa. App. filed May 13, 1895. The combination of a trolley wheel mounted on a pin, the ends of which extend through a bifurated portion of a trolley bar, lugs carrying levers supporting discs, the latter being normally pressed together by a spring and arms, by means of which the levers may be operated when desired.